The Official CompTIA IT Fundamentals+ Study Guide (Exam FC0-U61)

Acknowledgements

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About This Course

CompTIA Information Technology Fundamentals+ (ITF+) Certification is the essential qualification for beginning a career in IT Support. CompTIA (comptia.org) is a not-for-profit trade association set up in 1982 to advance the interests of IT professionals and companies. It is most well-known for its vendor-neutral IT certifications.

> *The CompTIA IT Fundamentals+ exam will certify the successful candidate has the knowledge and skills required to identify and explain the basics of computing, IT infrastructure, software development and database use. In addition, candidates will demonstrate their knowledge to install software, establish basic network connectivity and identify/prevent basic security risks. Further, this exam will assess the candidate's knowledge in the areas of troubleshooting theory and preventative maintenance of devices. This exam is intended for candidates who are advanced end users, are considering a career in IT, and are interested in pursuing professional-level certifications, such as A+.*
>
> *CompTIA IT Fundamentals+ Exam Objectives Blueprint*

This course will prepare you to take the FC0-U61 exam to obtain the IT Fundamentals+ certification and help you to learn some of the basic principles and techniques of providing PC, mobile, applications, and network support.

Course Outcomes

This course and the IT Fundamentals+ certification are designed as the starting point for a career in IT support. Obtaining ITF+ certification will show that you have the aptitude to pursue a professional-level certification, such as CompTIA A+.

Completing this course will also help you acquire the knowledge and skills to set up and use a computer at home securely and keep it in good working order and to provide informal support for PCs and simple computer networks to your colleagues in a small business.

On course completion, you will be able to:

- Set up a computer workstation and use basic software applications.
- Explain the functions and types of devices used within a computer system.
- Apply basic computer maintenance and support principles.
- Describe some principles of software and database development.
- Configure computers and mobile devices to connect to home networks and to the Internet.
- Identify security issues affecting the use of computers and networks.

Target Audience and Course Prerequisites

CompTIA IT Fundamentals+ is aimed at those considering a career in IT and computer-related fields. Consequently, there are no special prerequisites to start this course. We have made the assumption that you don't know much about how computers or software work, or even how to use them. Some experience with using a keyboard and mouse will be helpful but is not essential.

About the Course Material

The CompTIA IT Fundamentals+ exam contains assessment items based on objectives and example content listed in the exam blueprint, published by CompTIA. The objectives are divided into six **domains**, as listed below:

CompTIA ITF+ Certification Domains	Weighting
1.0 IT Concepts and Terminology	17%
2.0 Infrastructure	22%
3.0 Applications and Software	18%
4.0 Software Development	12%
5.0 Database Fundamentals	11%
6.0 Security	20%

This course is divided into five **modules**, each covering a different subject area. Each module is organized into several **units**, containing related topics for study.

- Module 1 / Using Computers
- Module 2 / Using Apps and Databases
- Module 3 / Using Computer Hardware
- Module 4 / Using Networks
- Module 5 / Security Concepts

As you can see, the course modules do not map directly to the CompTIA exam domains. Instead, we try to present topics and technologies in the order that will make it easiest for you to understand them. Each module and each unit starts with a list of the CompTIA domain objectives and content examples that will be covered so that you can track what you are learning against the original CompTIA syllabus. Each unit in a module is focused on explaining the exam objectives and content examples. Each unit has a set of **review questions** designed to test your knowledge of the topics covered in the unit. Answers to the review questions are provided at the end of the book.

In addition, the back of the book contains an **index** to help you look up key terms and concepts from the course and a **glossary** of terms and concepts used.

The following symbols are used to indicate different features in the course book:

Icon	Meaning
	A tip or warning about a feature or topic.
	A reference to another unit or to a website where more information on a topic can be found.
	Review questions to help test what you have learned.
	A hands-on lab exercise for you to practice skills learned during the lesson.

Completing the Labs

The practical lab exercises in this book are designed to be completed on a typical home computer running Microsoft Windows 10 Spring Creators Update (1803).

You should note some conventions used in the lab instructions:

- Text in **bold** refers to a command or part of a dialog.
- Text in **`Bold, Courier font`** represents something you should type.
- Text in **`COURIER FONT CAPITALS`** represents a key or key combo. For example, **`CTRL+C`** means press the **`CTRL`** and **`C`** keys at the same time.

Finding a Job

The CompTIA IT Fundamentals+ certification is a great thing to have to prove to employers that you know the basics of Information Technology and support, but it is not a golden ticket into employment. To get a job, you need to know where to look, how to write an effective resume and application letter, how to prepare for an interview, and generally how to impress potential employers.

Knowing where to start when looking for a job can be daunting, so the last section of the course contains a guide to help you research the local job market, write a resume and application letter, and prepare for an interview.

There's also advice on the next steps you might take in your career in IT support.

Four Steps to Getting Certified

This training material can help you prepare for and pass a related CompTIA certification exam or exams. In order to achieve CompTIA certification, you must register for and pass a CompTIA certification exam or exams. In order to become CompTIA certified, you must:

1) Review the certification objectives at certification.comptia.org/certifications/it-fundamentals to make sure you know what is covered in the exam.

2) After you have studied for the certification, use the "Taking the Exam" chapter to find tips on booking the test, the format of the exam, and what to expect. You can also take a free assessment and sample test from CompTIA at certification.comptia.org/training/practice-questions to get an idea what type of questions might be on the exam.

3) Purchase an exam voucher on the CompTIA Marketplace, which is located at store.comptia.org.

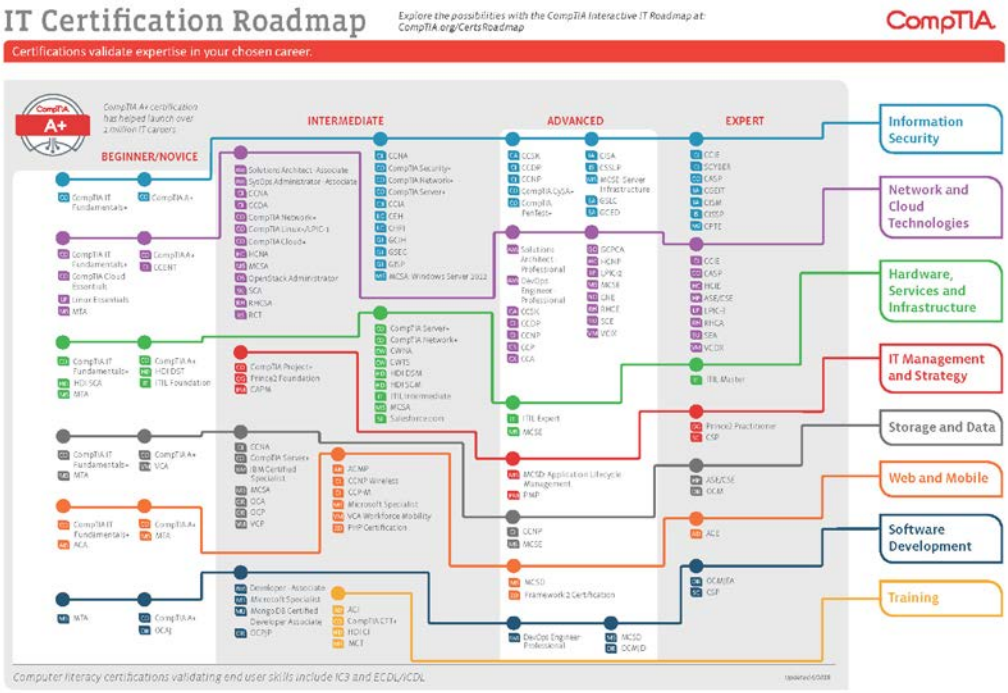
4) Select a certification exam provider and schedule a time to take your exam. You can find exam providers at www.pearsonvue.com/comptia/.

Visit CompTIA online at comptia.org to learn more about getting CompTIA certified.

CompTIA Career Pathway

This course will particularly benefit you in pursuing a career in supporting desktop personal computer users, in job roles such as Support Engineer, Maintenance Engineer, Desktop Engineer, Computer Administrator, or PC Support Analyst.

CompTIA offers a number of credentials that form a foundation for your career in technology and allow you to pursue specific areas of concentration. Depending on the path you choose to take, CompTIA certifications help you build upon your skills and knowledge, supporting learning throughout your entire career.



View the CompTIA career pathway at certification.comptia.org/why-certify/roadmap.

Module 1 / Using Computers

The following CompTIA IT Fundamentals+ domain objectives and examples are covered in this module:

CompTIA ITF+ Certification Domains	Weighting
1.0 IT Concepts and Terminology	17%
2.0 Infrastructure	22%
3.0 Applications and Software	18%
4.0 Software Development	12%
5.0 Database Fundamentals	11%
6.0 Security	20%

Refer To	Domain Objectives/Examples
Unit 1.1 / Common Computing Devices	**1.3 Illustrate the basics of computing and processing.** *Input • Processing • Output • Storage*
	2.6 Compare and contrast common computing devices and their purposes. *Mobile phones • Tablets • Laptops • Workstations • Servers • Gaming consoles • IoT (Home appliances, Home automation devices, Thermostats, Security systems, Modern cars, IP cameras, Streaming media devices, Medical devices)*
Unit 1.2 / Using a Workstation	**This unit does not cover specific exam domain objectives or content examples.**
Unit 1.3 / Using an OS	**3.1 Explain the purpose of operating systems.** *Interface between applications and hardware • Types of OS (Mobile device OS, Workstation OS, Server OS, Embedded OS, Firmware, Hypervisor [Type 1])*
Unit 1.4 / Managing an OS	**3.1 Manage applications and software.** *Disk management • Process management/scheduling (Kill process/end task) • Memory management • Access control/protection*
	3.2 Compare and contrast components of an operating system. *Services • Processes • Utilities (Task scheduling) • Interfaces (Console/command line, GUI)*

Refer To	Domain Objectives/Examples
Unit 1.5 / Troubleshooting and Support	**1.6 Explain the troubleshooting methodology.** *Identify the problem (Gather information, Duplicate the problem, if possible, Question users, Identify symptoms, Determine if anything has changed, Approach multiple problems individually) • Research knowledge base/Internet, if applicable • Establish a theory of probable cause (Question the obvious, Consider multiple approaches, Divide and conquer) • Test the theory to determine the cause (Once the theory is confirmed [confirmed root cause], determine the next steps to resolve the problem, If the theory is not confirmed, establish a new theory or escalate) • Establish a plan of action to resolve the problem and identify potential effects • Implement the solution or escalate as necessary • Verify full system functionality and, if applicable, implement preventive measures • Document findings/lessons learned, actions and outcomes*

Module 1 / Unit 1
Common Computing Devices

Objectives

On completion of this unit, you will be able to:

- Describe the basics of how a computer processes data.
- Describe the functions and capabilities of types of computing devices, such as PCs, servers, mobiles, and home automation.

Syllabus Objectives and Content Examples

This unit covers the following exam domain objectives and content examples:

- 1.3 Illustrate the basics of computing and processing.
  Input • Processing • Output • Storage
- 2.6 Compare and contrast common computing devices and their purposes.
  Mobile phones • Tablets • Laptops • Workstations • Servers • Gaming consoles • IoT (Home appliances, Home automation devices, Thermostats, Security systems, Modern cars, IP cameras, Streaming media devices, Medical devices)

Information Technology

An **Information Technology (IT)** system is one that processes, stores, and transfers information. *Information* can take many different forms including words, numbers, pictures, sound, or video. These can all be represented in an IT system using nothing more complicated than the binary digits one and zero. When information is stored and processed like this, it is often referred to as **data**. An IT system could use computers, the telecommunications network, and other programmable electronic devices. In fact, because of the importance of communications in IT, the term ICT (Information and Communications Technology) is often used in preference to IT.

We live in an "Information Age." The effective use of information is regarded as the defining element of the 21st century, as important as the industrial revolution before it. Computers and software programs enable us to process data and perform certain tasks much more quickly than we could ourselves. IT systems are very flexible and can be made to perform a variety of different tasks. IT networks, such as the global Internet, allow us to distribute and share information quickly.

Computer Hardware and Software

A **computer** is a system that manipulates data according to a set of instructions. Three elements are required for a computer to perform useful tasks: **hardware**, **software**, and the computer's **user**.

- The devices and components that make up a computer system are called hardware. Many parts are contained within the computer's case. Other parts are connected to the computer and are referred to as **peripheral devices**. Most peripherals allow information to be entered (input) and retrieved (output).

- The instructions that a computer follows come from software (computer programs). A basic software environment is established by the computer's **Operating System (OS)**. Software **applications**, such as word processors, spreadsheet programs, and payroll programs, can be installed within the OS to extend the range of things that the computer can be used to do. Having different software applications means that the same hardware can be put to a variety of uses.

- Software provides an **interface** for the user to control the computer system. The user creates data files by inputting information and selecting commands from the interface.

Basics of Computing and Processing

A good way to understand the functions of the different components of the PC is to think of them working as *interfaces*. Input and output hardware devices, such as a mouse and a monitor, provide an interface between the user and the computer; the operating system provides an interface between hardware components and software applications. In general terms, this works as follows:

- When a user selects a **command** (perhaps using a mouse to click an icon on the application toolbar), the **software application** receives the command and, using the functions of the **operating system**, converts it into a series of **instructions**, which are stored in **system memory**, commonly referred to as **Random Access Memory (RAM)**. Similarly, when a user types using the keyboard or scans a picture, the input is converted to digital data and stored in memory.

- The **Central Processing Unit (CPU)** retrieves each instruction or data file from memory and processes it.

- The CPU then writes the result back to memory and directs other components to perform actions. For example, it may instruct the display subsystem to update the image shown to the user or the storage subsystem to save data to a disk.

We'll discuss the types and features of system components such as the CPU and RAM in detail in Unit 3.1.

All the instructions and data processed by a computer are ultimately represented as strings of 1s and 0s. These 1s and 0s are represented as on or off states in the **transistors** that make up CPU and RAM components. A CPU can process billions of these **binary** instructions per second, which gives it the illusion of being able to "think."

Input, Output, Processing, and Storage

The four functions listed above represent most of the ways that data moves through a computer system:

- **Input**—the computer receives data entered by the user through peripheral devices, such as mice, keyboards, scanners, cameras, and microphones.

- **Processing**—the data is written to memory and manipulated by the CPU, acting on instructions from the operating system and applications software.

- **Output**—the processed data is shown or played to the user through an output device, such as a monitor or loudspeaker system.

- **Storage**—the data may be written to different types of storage devices, such as hard disks or optical discs, because data stored in most types of system memory is only preserved while the computer is powered on.

Additionally, most computers are configured in **networks**, allowing them to exchange data. You can think of networking as a special class of input and output, but it is probably more helpful to conceive of it as a separate function.

Personal Computers (PC)

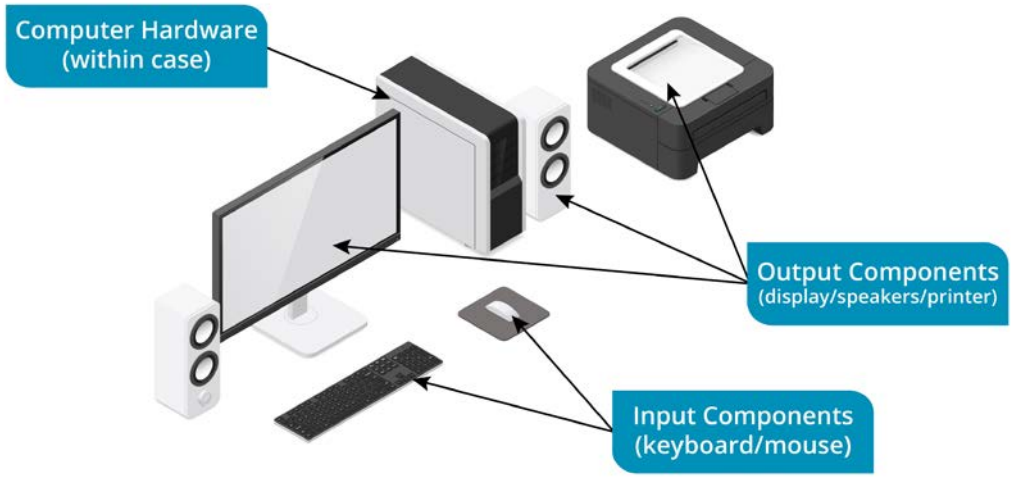
There are many different types of computer. Some of the first types of **mainframe** computers created in the 1960s and 1970s are unrecognizable from the sorts of desktop and laptop computers you may be familiar with. The term "Personal Computer" is generally understood to apply to versions of the **IBM PC**, developed in 1981. The IBM PC was based on a microprocessor or Central Processing Unit (CPU) designed by **Intel**. This is also called the x86 architecture or platform. This type of computer was fundamentally different to mainframes as it was operated directly by the end user.

While technologies and performance have completely transformed what we know as PCs from the boxes available in 1981, most **workstation** and **laptop** personal computers designed for home and office use are still based on the IBM PC design and x86 platform. As this PC platform matured, it came to be associated with use of Microsoft's Windows operating system software. Hardware and software development for PCs is often (but not exclusively) undertaken with Windows compatibility in mind.

In the last couple of decades however, personal computers have become available as much smaller, more portable devices such as **tablets** and **smartphones**. These devices can use different hardware platforms and operating systems. This has been coupled with the growth of the **Internet** as a global data communications network. As the miniaturization of electronics continues, many "ordinary" appliances and systems are being designed with processing and communications capabilities, creating an **Internet of Things (IoT)**.

Desktop and Workstation Computers

A **workstation** type of PC is housed in a case that can sit on or under a desk. Consequently, they are often referred to as **desktop** PCs or just as **desktops**. A desktop computer can be used independently by a single user to run powerful software applications with many functions. It can also be used as a **network client** to access shared resources.



PC system showing processing and storage components (within case), input components (keyboard and mouse), and output components (display, speakers, printer). Image © 123rf.com.

Sometimes the terms PC, desktop computer, and workstation are used interchangeably. Quite often however, the term workstation is used to mean a particularly powerful type of desktop computer.

Some of a PC's components are attached to a **motherboard** contained within the computer's case. However, a desktop PC also requires the use of **peripheral devices**, connected to the motherboard via ports aligned to holes in the case. Some peripheral devices, such as a mouse and keyboard for input and a monitor for output, are essential. Others, such as speakers and microphone or a printer, are optional.

The advantage of desktops is that the basic design can be modified with higher or lower specified components and optional features, making a particular model better suited to different tasks. A workstation-class computer with higher specification components, such as CPU and system memory, will cost more but be able to process data faster. The computer's performance is largely determined by the following factors:

- The **speed** of the CPU determines the basic speed of the computer.
- More **system memory** makes it possible to run more applications simultaneously and process large amounts of data more quickly.
- The **capacity** of the main storage drive determines how much data can be stored on the computer when it is switched off.
- Optional components extend the range of things the computer can do (for example, a sound card makes it possible to play audio while a webcam allows sound and video recording).
- The quality of peripherals such as the display, mouse, and keyboard make the computer more comfortable to use (this is referred to as **ergonomics**).

We are simplifying a bit here. In fact, the type and speed of the main storage drive also has a big impact on system speed. Legacy hard drives were a serious performance bottleneck, but these are being replaced by solid state drives, which can work much more quickly. Storage devices are discussed in more detail in Unit 3.4. The graphics subsystem is also an important performance factor.

Desktop PCs can also be purchased as "all-in-one" units. All-in-one means that the computer components (except the keyboard and mouse) are contained within the monitor case.

All-in-One PC—the system components are all contained within the monitor case. Image © 123rf.com.

Servers

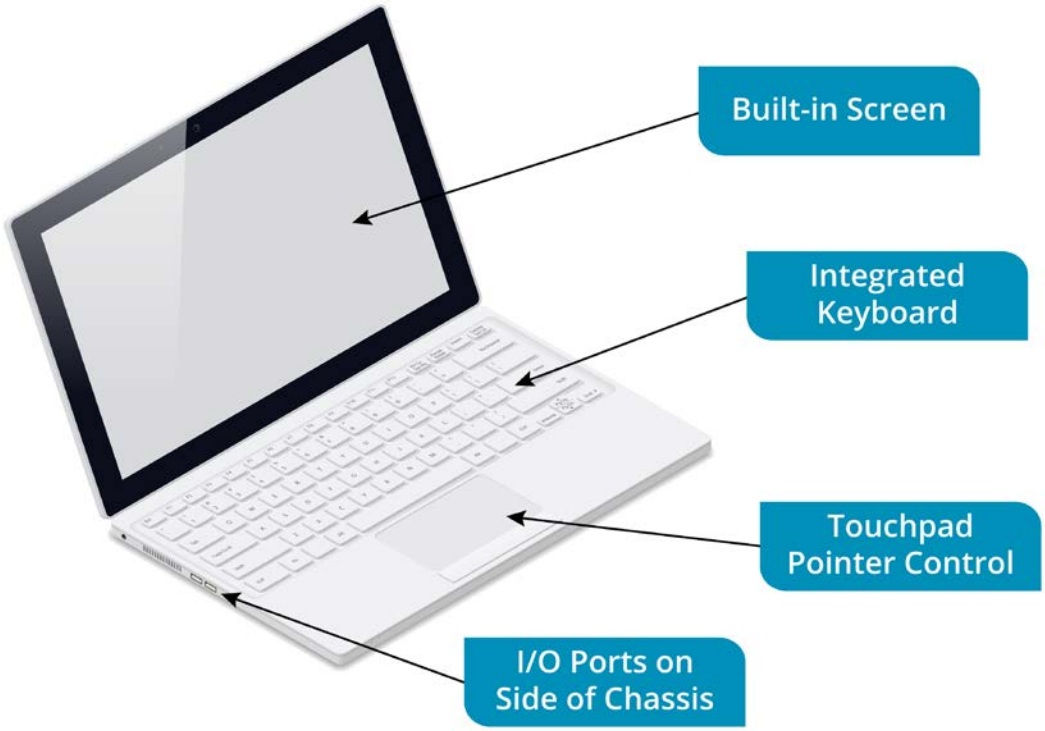
A **server** is any computer providing services to other computers, but usually the term server implies a powerful computer that supports a number of users *simultaneously* in a computer **network**. Most servers use the same type of components as a desktop. The main difference is that the components are more powerful and more reliable, and consequently more expensive. If a desktop PC stops working, a single user may be unable to do their job; if a server computer stops working, *tens* or even *hundreds* of users may not be able to do their jobs. Consequently, servers need to be very reliable. This is achieved by specifying high quality components and also by using extra copies of components for redundancy. This makes a server system **fault tolerant**.

Server systems are also, usually designed to be easy to expand and upgrade with additional or improved components. Very often, server computers use a special type of case designed to fit into a steel **rack** shelving system.

You should also understand that the term server can refer either to hardware or software. A hardware server may be running many software servers and sometimes different types of software servers. Examples of types of software servers include web servers, email servers, database servers, authentication servers, and so on.

Laptops

A **laptop** computer is one that integrates the display, system components, and input/output devices within a single, portable case (or chassis).



Distinctive features of a laptop computer, including the built-in screen, Integrated keyboard, touchpad pointer control, and I/O ports (on both sides and rear of chassis). Image © 123rf.com.

The main features distinguishing laptops from desktop PCs are:

- **Size and weight**—laptops weigh between 1 and 4 kg (2–9 lbs).
- **Display type**—laptops use flat-panel display technologies to provide lightweight, slimline screens that are built into the case. Laptop screen sizes come in the ranges 11–14", 15–16", and 17"+.
- **Input devices**—the main input devices are integrated into the case, such as a built-in keyboard, a touchpad instead of mouse, and/or a touchscreen.
- **Power source**—portable computers can be run from internal battery packs as well as from building power.
- **Components**—laptops often use different system components (CPU, RAM, and graphics) that are smaller, lighter, and draw less power than desktop versions.
- **Networking**—portable computers use wireless radio technologies to connect to networks rather than cabled connections.

Small laptops can also be described as notebooks and subnotebooks, while bigger models are often called "desktop replacements." The term Ultrabook is used for laptops meeting a particular Intel specification for performance, size/weight, and battery life. There are also hybrid laptops that can be used like a tablet (see below) as well as like a traditional laptop.

PC and Laptop Vendors

Most companies producing PCs and laptops are referred to as **Original Equipment Manufacturers (OEM)**. This is because rather than making each component that goes into a PC, they source components such as CPUs and RAM modules from manufacturers and put them together as a branded PC system.

While there are many vendors serving local and special interest markets, global PC manufacturing is dominated by Dell, Hewlett-Packard (HP)/Compaq, Lenovo (previously IBM's PC division), Acer, and Huawei with Samsung, Sony, Toshiba, and Asus also strong in the laptop and hybrid markets. Another personal computer vendor, Apple, ship Macintosh computers with a different operating system (Apple Mac OS) and a different hardware platform to the IBM PC-compatible vendors. There are also chromebooks, laptops built to run Chrome OS and interface primarily with Google's web apps.

The market for server computers is dominated by Dell, HP Enterprise (HPE), and Lenovo.

Mobile Devices

Many of the uses of PCs and laptops have been superseded by smaller personal devices or by specialized devices.

Smartphones and Tablets

A **smartphone** is a device with roughly the same functionality as a personal computer that can be held in one hand. Previous handheld computers, known as Personal Digital Assistants (PDA), and earlier types of mobile phones with some software functionality (feature phones), were hampered by clumsy user interfaces. Modern smartphones use touchscreen displays, making them much easier to operate. Most smartphones have a screen size between 4.5" and 5.7".

Typical smartphone form factor. Image © 123rf.com.

Prior to the Apple iPad, **tablet** PCs were usually laptops with touchscreens. The iPad defined a new form factor; smaller than a laptop and with no keyboard. Tablet screens tend to be sized between 7” and 10”.

Smartphones sized between the 5" and 7" form factors are often called phablets.

Many Windows mobile devices adopt a hybrid approach where a laptop can be converted into a tablet by flipping the screen. Microsoft's Surface Pro tablet is available with a detachable keyboard, which can also function as a cover for the screen. Other vendors are also producing "two-in-one" devices that can function as both a laptop and a tablet.

The main smartphone and tablet vendors are Apple and Samsung. Other vendors include LG, HTC, Huawei, Motorola/Lenovo, Microsoft, Nokia, Sony, and Amazon.

Internet of Things (IoT) Devices

Aside from devices easily recognizable as "computers," your home and office are quite likely populated by other consumer electronics devices connected to each other and to the Internet. The **Internet of Things (IoT)** refers to a world in which many different types of things are embedded with processing and networking functionality. Processing and networking functionality can be provisioned by very small chips, so the "things" can range from motor vehicles and washing machines to clothing and birthday cards.

Home Automation

Pretty much anything from a clock to an alarm system or a refrigerator can be controlled over the Internet by **home automation** software, if the appliance or device is "smart." Often, sitting at the heart of this automation, is a **hub** to which other devices connect. Hubs are usually controlled using voice recognition systems and smartphone apps. Some of the major vendors include Amazon (Alexa voice recognition), Samsung (S Voice), Apple (Siri), and Logitech (working with either Alexa or Google Assistant), but there are many others.

One of the critical points in building a "smart" or "digital" home or office solution is ensuring compatibility between the networking or communications standards supported by the hub and the appliances. Most devices support ordinary Wi-Fi standards-based wireless networking, but some may require connectivity standards designed for low power use, such as Z-Wave, ZigBee, or Bluetooth LE.

Some of the specific home automation product categories include:

- **Thermostats**—monitor and adjust your home or office Heating, Ventilation, and Air Conditioning (HVAC) controls from an app installed on your phone.
- **Security systems**—monitor and control alarms, locks, lighting, and videophone entry systems remotely.
- **IP cameras**—often used for security, these devices connect to Internet Protocol (IP)-based networks such as the Internet and support direct upload and sync to cloud storage for remote monitoring.

- **Home appliances**—check the contents of your refrigerator from your smartphone while out shopping or start the washing machine cycle so that it has finished just as you get back to your house.
- **Streaming media**—play content stored on a storage device through any smart speaker or TV connected to the home network.

Modern Cars and Drones

Modern motor vehicles use a substantial amount of electronics. As well as computer systems to control the vehicle's engine and brakes, there may be embedded systems for in-vehicle entertainment and for navigation (sat-nav) using Global Positioning Systems (GPS) to identify the vehicle's precise location. Some vehicles are now, also fitted with a "black box," or event data recorder, that can log the car's telemetry (acceleration, braking, and position).

There are also sophisticated systems to control the vehicle on behalf of the driver, including automatic collision detection and avoidance, and parking assist. Companies are experimenting with fully-automated self-driving or autonomous vehicles.

Another rapidly developing sector is that of **Unmanned Aerial Vehicles (UAV)**. This sector ranges from full-size fixed wing aircraft to much smaller multi-rotor hover drones.

Medical Devices

Medical devices represent another class of devices where use of electronics to remotely monitor and configure the appliance is expanding rapidly. It is important to recognize that use of these devices is not confined to hospitals and clinics but includes portable devices such as cardiac monitors/defibrillators and insulin pumps. These allow doctors and nurses to remotely monitor a patient and potentially to adjust dosage levels or other settings without the patient having to visit the care provider.

Gaming Consoles

A **gaming console** contains many of the same components as a workstation. Gaming consoles have powerful CPUs and graphics processors, plus Ethernet and Wi-Fi for wired and wireless home networking and Internet connectivity. Web cameras and microphones are also available as peripherals. The main difference to a workstation is that a console is designed to be operated by a gaming pad rather than a keyboard and mouse, though these are often also available as options. A gaming console would use an HD (High Definition) TV for a display.

The market for consoles is dominated by Sony (PlayStation), Microsoft (Xbox), and Nintendo (Wii and Switch).

There are also handheld game consoles, such as Nintendo's 3DS and Switch, and Sony's Vita. These come with Wi-Fi to connect to the Internet or to other consoles.

Review Questions / Module 1 / Unit 1 / Common Computing Devices

Answer these questions to test what you have learned in this unit. You can review the model answers at the end of the book.

1) True or false? All types of computers use CPU and system memory.

2) What type of computer is most likely to need peripheral devices?

3) What type of computer is best suited for using in a job where you have to make notes and be able to move around easily?

4) Why don't laptops make good servers?

5) Why isn't a smartphone a good tool for writing a report?

6) What type(s) of IoT appliance are less likely to be controlled via a home automation hub?