Introduction

Personal computers are, at once, horrendously (awfully) complicated yet simpler than one might expect. How can this be? Computer professionals spend years working on computers, but never learning all there is to know. There's just too much information for one human being to absorb in a lifetime, especially because the technology changes continually and there are so many different types of each component. However, it is not necessary to know anything close to "everything" to be able to repair or even build computers. Because the parts are all modular, most technicians rarely, if ever, use a soldering iron. When a component such as a modem has a hardware problem, you wouldn't spend hours trying to repair it. You simply replace it—a procedure that normally takes a few minutes. Other problems can be corrected through software. So, while it cannot be said that repairing computers is "simple," it is nowhere near as complicated as the complexity of the computer would suggest.

A computer technician must be a jack-of-all-trades: a software expert in various operating systems and applications; a hardware expert in everything ranging from processors to the latest laser printer; a communicator extraordinaire to handle the occasional irate, irrational, or computer illiterate customer; a good listener to elicit computer symptoms from customers (and from the computer); an empathetic counselor to make customers feel good about their computers and confident in the technician's skills; and finally, a master juggler of time and priorities. These traits do not come overnight and not all of them can be taught—but a technician can constantly develop and fine-tune each of them.

This manual covers computer support basics—the knowledge to get you started in the technology support industry. Standards relating to computer repair are important, and technicians must recognize old and current standards and stay abreast of emerging ones. Some computer standards allow a great deal of leeway for manufacturers and therefore cause more heartburn for computer technicians. However, if a technician understands the basics of computer repair, the problems from manufacturer design or hardware not covered in this book can still be resolved.

There is no substitute for experience, and no substitute for knowing the basics of how individual computer parts work. The basics help you understand other emerging technologies as well as proprietary devices. Once a technician has a job in the industry, past hands-on time will increase his or her depth of knowledge and experience. Use your classroom hands-on time wisely. The *classroom is the place to learn the ropes—the basics.*

Having a teacher to guide you through the basics, classmates with which to share information, and a book to supplement your instruction are important for getting you started. This is a lecture, not a reference book. It serves as a supplement to your instructor of computer repair.

The best quality a technician can possess is ***logic***. A good technician narrows a problem to a general area, subdivides the problem into possible culprits, and eliminates the possibilities one by- one efficiently and logically. A technician is like a detective, constantly looking for clues, using common sense and deductive reasoning, gathering information from the computer and the computer user, and finally solving the mystery. As one computer teacher puts it, "*a computer technician works smart, not hard*." Detective work is integral to a technician's job.

This can help you achieve technical competence, but you should never forget the computer users. Many technicians like to work with things—computers, networks, printers, and so on—more than with people. This text cannot teach you to care about the people who use technology. You must remember that communication is as important as your technical skills.

Repairing computers is rewarding, but it can be frustrating if you do not understand the basics. With good reasoning ability and a good foundation in computer repair, no problem goes unsolved. Remember that if every repair were simple, then no one would need technicians. Enjoy the class!

Technician Qualities

Two of the most important qualities that a technician can have are active listening skills and attitude.

Active listening means that you truly listen to what the person (who is having the problem) is saying. Having active listening skills involves good eye contact, nodding your head every now and then to show you are following the conversation, taking notes on important details, and avoiding distractions such as incoming cell phone calls or other activities. Clarify customer statements by asking pertinent questions and avoid interrupting the customer. 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. Do not act superior because you know terms and things that they do not.

A **positive attitude** is probably the best quality a technician can possess. Many technicians treat customers abruptly, not taking the time to listen to their problem or to find the best solution. A good attitude is helpful when a user is upset because their computer or attached device is not working properly. Do not undermine 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.

A technician must be familiar with and thoroughly understand computer terminology to

(1) speak intelligently to other technical support staff in clear, concise, and direct statements;

(2) explain the problem to the user; and

(3) be proficient in the field. The field changes so quickly that technicians must constantly update their skills.

Unfortunately, some computer technicians use the technical language of the trade when speaking with people who are not attuned to the lingo. Using too many technical terms around end users serves only to confuse and irritate them. A technician should avoid using slang, jargon, acronyms, and abbreviations. In addition to knowing and using the correct terminology, a technician must use it appropriately, and explain computer terms with simple, everyday language and examples. This book explains computer terminology in easy-to-understand terms and provides analogies that can be used when dealing with customers.

Why Do We Need Computer?

The answer is clear. In all aspects of daily living – education, work, pleasure, entertainment, communication, marketing, business and the like, computer is always present. With the advent of globalization, technological revolution has taken place. Man has to be computer literate because that is the demand of time. If he does not go with the tide, he will be left behind. Today, there is no doubt that majority of the human beings are computer literate. There are three measurements to assess the level of computer literacy.

a. Awareness – When you begin to study computers, you will be aware of their importance, versatility and pervasiveness in our society.
b. Knowledge. You will learn that computers are and how they function. This requires knowing some technical jargons in order to understand the computer language.
c. Interaction – The best way to understand computers is to use it directly for some simple applications, like doing research via the internet, mailing and chatting electronically.

<u>WHAT IS A COMPUTER</u>? – *It is an electronic device designed to manipulate data so that the useful information can be stored and retrieved.*

- An intelligent machine that is capable of connecting and communicating
- A powerful tool that can be used as basis for decision making. (Basic Foundation of I.T., .(Albano, et. al.)

A **COMPUTER** is a machine that manipulates data according to a set of instructions called a computer program. (Wikipedia Encyclopedia)

A **COMPUTER** is an electronic device that performs certain arithmetic and logical operations without any errors. (Wikipedia)

Businesses – defines computer as "*<u>only a tool to make their work easier</u>*."

Characteristics of a Computer:

1. It is a machine. – it runs through electricity.
2. It is electronic. – it is made up of millions of transistors/ electronic parts. (e.g. CPU, RAM, ROM)
3. It is automatic. – continuously run once started.
4. It can manipulate data. – process / organized data
5. It has memory. – capable of remembering or memory recall
6. It has logic function. – it can produced logical results based on alternative course of action. Can produce results after instructions were fed into it.

Computer Capabilities:

1. Speed – can process data faster than any other machine designed to perform a similar task. Speed can reach up to million per second.
2. Repetitiveness – can tirelessly perform the same function or operations millions of times.
3. Accuracy – no other system can produce as such accuracy as the computer system.
4. Logical Operations – can make decisions based on alternative courses of action.
5. Store and recall information – data storage capability is unique because it cannot forget stored data or facts. It stores vast amounts of information at high speed.
6. Self-checking – verifies the accuracy of its own by parity check. It counts the number of characters it has stored to make sure there is no loss of data during processing.
7. Self-operating – capable of executing instruction on its own, though even without man's control on it.

Computer Limitations:

1. Dependence on the prepared instructions.
2. Inability to derive meanings from objects.
3. Inability to generate information on its own.
4. It cannot correct wrong instructions.

CLASSIFICATION OF COMPUTERS

A. ACCORDING TO PURPOSE

1. General-Purpose Computers – Designed to handle a variety of different problems and to meet different needs. These are strong in versatility but are normally weak in speed and efficiency.
2. Special-Purpose Computers – Designed to handle a specific problem or to perform a specific task. Example of use are for collecting highway tools, airline reservations, satellite tracking, air traffic control, and industrial process control.

B. ACCORDING TO TYPES OF DATA HANDLED

1. Analog Computers – Commonly used for scientific and engineering problems, particularly in chemical industries, electric power plants, and petroleum refineries. These deal with continuously changing physical data (such as pressure, temperature, and current). Example: Speedometer-analog device that shows the changes in the speed of the automobile as analogous to the changes in the speed of the camshaft's rotation.
2. Digital Computers – Specializes in counting. It handles values that are in a separate or distinct form (discrete).
3. Hybrid Computers – Incorporate both analog and digital features of a single computer. Used in working out special types of problems in science and various areas of engineering.

C. FOUR TYPES OF COMPUTERS ACCORDING TO CAPACITY

1. Microcomputers
2. Mini Computers
3. Mainframe Computers
4. Supercomputers

1. Microcomputers (Personal computers)

Microcomputers are the most common type of computers used by people today, whether in a workplace, at school or on the desk at home. The term "microcomputer" was introduced with the advent of single chip microprocessors.

Microcomputer – generally a synonym for the more common term, personal computer or PC, a computer designed for an individual. It uses microprocessor technology to input, manipulate, store and output data.

Two Classifications of Microcomputers

1. **Personal Computer or PC** – widely popular with people of all lifestyles because they are powerful, affordable and easy to use. Ex. (Desktop, Mini-tower, Midi-tower, Full-tower.)

:

- Desktop computers – A case and a display, put under and on a desk.
- In-car computers ("carputers") – Built into a car, for entertainment, navigation, etc.
- Game consoles – Fixed computers specialized for entertainment purposes (video games).

A separate class is that of mobile devices:

2. **Portable Computer** – include, laptops or notebooks, sub-notebook, tablet computer and personal digital assistants. They are small enough to move easily from one place to another and they can operate on batteries.

- Laptops, notebook computers and Palmtop computers – Portable and all in one case. Varying sizes, but other than smartbooks expected to be "full" computers without limitations.
- Tablet computer – Like laptops, but with a touch-screen, sometimes entirely replacing the physical keyboard.
- Smartphones, smartbooks and PDAs (personal digital assistants) – Small handheld computers with limited hardware.
- Programmable calculator– Like small handhelds, but specialized on mathematical work.
- Handheld game consoles – The same as game consoles, but small and portable.

2. Minicomputers (Midrange computers)

Minicomputer – is a multi-processing system capable of supporting from 4 to about 200 users simultaneously.
Ex. IBM AS/400e

A minicomputer (colloquially, mini) is a class of multi-user computers that lies in the middle range of the computing spectrum, in between the smallest multi-user systems (mainframe computers) and the largest single-user systems (microcomputers or personal computers). The contemporary term for this class of system is midrange computer, such as the higher-end SPARC, POWER and Itanium -based systems from Oracle Corporation, IBM and Hewlett-Packard. E.g.- Laboratory computers

3. Mainframe computers

Mainframe Computer – a very large and expensive computer capable of supporting hundreds, or even thousands of users simultaneously. Ex. IBM 3090, Amdahl 5890.

The term mainframe computer was created to distinguish the traditional, large, institutional computer intended to service multiple users from the smaller, single user machines. These computers are capable of handling and processing very large amounts of data quickly. Mainframe computers are used in large institutions such as government, banks and large corporations. They are measured in MIPS (million instructions per second) and respond to up to 100s of millions of users at a time.

4. Supercomputer

Supercomputer – the fastest type of computer, very expensive and are employed for specialized applications that require immense amounts of mathematical calculations.

A supercomputer is focused on performing tasks involving intense numerical calculations such as weather forecasting, fluid dynamics, nuclear simulations, theoretical astrophysics, and complex scientific computations. A supercomputer is a computer that is at the frontline of current processing capacity, particularly speed of calculation. The term supercomputer itself is rather fluid, and the speed of today's supercomputers tends to become typical of tomorrow's ordinary computer. Supercomputer processing speeds are measured in floating point operations per second or FLOPS. An example of a floating point operation is the calculation of mathematical equations in real numbers. In terms of computational capability, memory size and speed, I/O technology, and topological issues such as bandwidth and latency, supercomputers are the most powerful, are very expensive, and not cost-effective just to perform batch or transaction processing. Transaction processing is handled by less powerful computers such as server computers or mainframes.

Classes by function

Servers

Server usually refers to a computer that is dedicated to provide a service. For example, a computer dedicated to a database may be called a "database server". "File servers" manage a large collection of computer files. "Web servers" process web pages and web applications. Many smaller servers are actually personal computers that have been dedicated to provide services for other computers.

Workstations

Workstations are computers that are intended to serve one user and may contain special hardware enhancements not found on a personal computer.

Information appliances

Information appliances are computers specially designed to perform a specific user-friendly function —such as playing music, photography, or editing text. The term is most commonly applied to mobile devices, though there are also portable and desktop devices of this class.

Embedded computers

Embedded computers are computers that are a part of a machine or device. Embedded computers generally execute a program that is stored in non-volatile memory and is only intended to operate a specific machine or device. Embedded computers are very common. Embedded computers are typically required to operate continuously without being reset or rebooted, and once employed in their task the software usually cannot be modified. An automobile may contain a number of embedded computers; however, a washing machine and a DVD player would contain only one. The central processing units (CPUs) used in embedded computers are often sufficient only for the computational requirements of the specific application and may be slower and cheaper than CPUs found in a personal computer.

Applications of Computers

Computers have their application or utility everywhere. We find their applications in almost every sphere of life–particularly in fields where computations are required to be done at a very fast speed and where data is so complicated that the human brain finds it difficult to cope up with.

As you must be aware, computer now-a-days are being used almost in every department to do the work at a greater speed and accuracy. They can keep the record of all the employees and prepare their pay bill in a matter of minutes every month. They can keep automatic checks on the stock of a particular item. Some of the prominent areas of computer applications are:

1. **In Tourism**: Hotels use computers to speed up billing and checkout the availability of rooms. So is the case with railways and airline reservations for booking tickets. Architects can display their scale models on a computer and study them from various angles and perspectives. Structural problems can now be solved quickly and accurately.

2. **In Banks**: Banks also have started using computers extensively. Terminals are provided in the branch and the main computer is located centrally. This enables the branches to use the central computer system for information on things such as current balance, deposits, overdrafts, interest charges, etc. MICR encoded cheques can be read and sorted out with a speed of 3000 cheques per minute by computers as compared to hours taken by manual sorting. Electronic funds transfer (EFT) allows a person to transfer funds through computer signals over wires and telephone lines making the work possible in a very short time.

3. **In Industry**: Computers are finding their greatest use in factories and industries of all kinds. They have taken over the work ranging from monotonous and risky jobs like welding to highly complex jobs such as process control. Drills, saws and entire assembly lines can be computerized. Moreover, quality control tests and the manufacturing of products, which require a lot of refinement, are done with the help of computers. Not only this, Thermal Power Plants, Oil refineries and chemical industries fully depend on computerized control systems because in such industries the lag between two major events may be just a fraction of a second.

4. **In Transportation**: Today computers have made it possible for planes to land in foggy and stormy atmosphere also. The aircraft has a variety of sensors, which measure the plane’s altitude, position, speed, height and direction. Computer use all this information to keep the plane flying in the right direction. In fact, the Auto–pilot feature has made the work of pilot much easy.

5. **In Education**: Computers have proved to be excellent teachers. They can possess the knowledge given to them by the experts and teach you with all the patience in the world. You may like to repeat a lesson hundred times, go ahead, you may get tired but the computer will keep on teaching you. Computer based instructions (CBI) and Computer Aided Learning (CAL) are common tools used for teaching. Computer based encyclopedia such as Britannica provide you enormous amount of information on anything.

   Some Uses of Computers in Education
   1. Teaching
   2. Learning
   3. Testing and Evaluation process
   4. Guidance purposes
   5. Library
   6. School Administration

6. **In Entertainment**: Computers are also great entertainers. Many computer games are available which are like the traditional games like chess, football, cricket, etc. Dungeons and dragons provide the opportunity to test your memory and ability to think. Other games like Braino and Volcano test your knowledge.

   Retrieved from: http://www.itsavvy.in/applications-computers-fields

IMPORTANT COMPUTER REPAIR SAFETY TIPS

In addition to being an afternoon of great fun, PC repair can save you loads of time and money. No amount of fun, money or time is enough, though, to compromise your safety.

Keep these important tips in mind as you work inside your computer:

Health and Safety – PC Repair

People often ignore the risks involved in opening and operating on your computers interior, or many people don't realize just how dangerous it can be. Whether you're a beginner or a professional, health and safety is of the out-most importance, thankfully, staying safe while working on your computer is relatively easy.

The first step, which is also the most important one, is to stop the flow of electricity into your computer. Turn off your computer and remove anything that is plugged into it. If your computer was only turned off, after removing the plug, wait a few minutes before touching any of the components.

If your motherboard has lights that light up when being supplied power, you can use them as an indication as to whether or not there is still power going through the computer. Some Power supply units come with a power switch at the back of them, make sure you switch that off as well.

Remember to Flip the Switch

Always, always, always remember to turn the power off before servicing anything. This should always be your first step. Do not even open the computer case unless the power is turned off. Many computers have a number of lights inside that serve certain functions so check to see that no lights are on. If any are still on then the power is probably not completely off.

Many power supply units have a switch on the back, killing power to the device and ultimately the rest of your PC. If your PSU has one, be sure to turn it to the off position.

If you're working on a laptop, netbook, or tablet, be sure to remove the battery, as well as disconnect the AC power, before removing or disassembling anything.

Unplug for Extra Safety

As a second precaution, it is wise to unplug the computer from the wall or power strip. If there was any doubt as to whether the computer was off before, it's settled now.

Avoid Smoke and Smells
Warning of the senses

If you smell something burning, see a component that is burnt or hear something that doesn't sound normal, stop what you're doing, make sure there is no power computer to the computer, find the culprit, remove and replace it as soon as possible. If it is the power supply, be extremely careful, the capacitors within the PSU store electricity and can give off life threatening jolts.

See smoke coming from the power supply or inside the case or smell a burning or solder scent? If so:

1. Stop what you're doing immediately.
2. Unplug the computer from the wall.
3. Allow the PC to cool or discharge unplugged for at least 5 minutes.

Finally, if you know which device was generating the smoke or smell, remove and replace it as soon as you can. Don't try to repair a device that's been damaged to this extent, especially if it's a power supply.

Remove Hand Jewelry

An easy way to get electrocuted is to work around a high voltage device like a power supply with metal rings, watches, or bracelets on. Remove anything conductive from your hands before working inside your computer, especially if you're doing something like testing your power supply.

Avoid Capacitors

Capacitors are miniature electronic components contained in many of the parts inside a PC. Capacitors can store electric charge for a short while after the power is turned off so it's a wise decision to wait a few minutes after pulling the plug before working on your PC.

Never Service the Non-Serviceable

When you come across labels that say "No serviceable components inside" don't take it as a challenge or even a suggestion. This is a serious statement.

Some parts of a computer are just not meant to be repaired, even by most professional computer repair persons. You will usually see this warning on power supply units but you may also see them on monitors, hard drives, optical drives and other dangerous or highly sensitive components.

Source: http://pcsupport.about.com/od/safetyconsiderations/qt/safety_tips.htm

Troubleshooting and Repair Guide

There is nothing more upsetting for a PC user than when there is a problem with their machine. This upset can turn quickly to frustration when the problem seems to be impossible to solve, or even to understand. Every PC user has experienced these feelings, but it is in most cases possible to both diagnose and correct most problems with the typical PC. And with some help, you can usually do it yourself.

The most important resource you can have at your disposal when you are trying to troubleshoot a problem with your PC is: experience. Those who have done a lot of work diagnosing and correcting problems with a wide variety of PCs develop a knack for recognizing problem situations that they have seen before. They also learn (and invent) techniques that make it possible for them to get to the root of a problem quickly.

There's no substitute for experience, but I'm hoping that this Guide will be the next best thing. I have accumulated here the experience of myself and many other knowledgeable PC users, upgraders and maintainers, to help you learn how to detect and correct many common problems that plague PC users. This includes both general rules of thumb regarding how to troubleshoot your PC, as well as information on dealing with vendor warranties, and repairing your machine.

The heart of this Guide is The Troubleshooting Expert, an expert system database of questions and answers that will help you to quickly find a solution to the most common problems with PCs. Over time I will continue to add to and expand this Expert so that it becomes an increasingly more and more useful tool for tackling the woes that plague the computer user.

General Troubleshooting Techniques

"Give a man a fish, and you feed him for a day. Teach a man to fish, and you feed him for a lifetime." -- Chinese proverb

Many people will probably come to this Troubleshooting Guide looking for the answer to a specific problem that they are having with their PC. The Troubleshooting Expert can often help with this. However it is worthwhile if you are having a problem to read first the general troubleshooting information in this chapter. Using it you may be able to not only solve your current problem, but also develop your own skill as a troubleshooter so you can correct future problems more easily and quickly.

This chapter contains descriptions of most of the techniques and tricks that I use when I have a difficult problem that I need to diagnose and correct. They are based on my own experiences and my study of problem-solving methods, as well as knowledge of various problem situations that I have accumulated.

Troubleshooting and Your Mental State

Very few people seem to understand how incredibly important the mental state is of the person who is attempting to troubleshoot a system. I have personally seen many times (and often with myself as the subject) the difference between a person in the right mental state and one who is not, in the ability to identify and correct system problems. It can easily be the difference between a problem that is fixed in minutes and one that languishes for hours or days.

I would urge all troubleshooters to read this section and keep these rules of thumb in mind as you try to work out your PC problems. If you get stuck, come back and refer to them again. You may be surprised how much just thinking about the problem the right way can make it much easier to solve.

Don't Panic or Overestimate the Magnitude of the Problem

Probably the most important single thing to keep in mind when you find a problem with your PC is not to panic. Being in "panic mode" makes it extremely difficult for you to work on solving the problem, and in many cases the panic will turn out to be unwarranted anyway. Remember that most PC problems do not have to be solved with a clock ticking away in the background; this isn't a time bomb you are dealing with and if it is easier to turn off the PC and deal with the problem later, do so.

In fact, there are many problems with PCs that appear to be very serious but in fact are not. It isn't always possible to tell at the beginning how serious a problem is just by its outward symptoms. For example, there are some problems that can manifest themselves with your hard disk appearing to be crashed and all of its data lost. Sometimes real crashes do occur, but there are other problems that can cause a disk to appear crashed when really the problem is simple and can be fixed in a matter of a few minutes.

Panicking can also lead you to jump to a solution to the perceived problem before you really understand it, which can make matters worse.

Don't Jump to the Solution Before You Understand the Problem

I have noticed in my studies of problem-solving techniques that there seem to be differences in the way that many Westerners approach problems and the way that many of those of the East seem to. In Japan, for example, when a problem arises, the focus is generally kept on analyzing the problem for a lengthy period of time, and using specific techniques. In the U.S. and many other Western countries, when a problem arises the focus seems to shift very quickly from the problem to implementing the solution.

The difficulty with jumping quickly to the solution to a problem is that if you don't take enough time to really understand what the problem is, you may end up applying the wrong fix to the situation and making things worse. You will also make it more difficult to figure out what caused the problem so that you can prevent it from recurring. Even if you resolve the situation this time, you may find a similar issue cropping up again in the near future.

The key is to exercise patience. If possible, you want to take enough time to make sure that you understand what you are seeing and what the root cause is. (Although with some sorts of intermittent problems you may not be able to explore the root cause easily). Only by addressing the root cause of the problem will you be able to take the most effective corrective steps and ensure that the problem will go away permanently.

Don't Be Stubborn

I'm a very stubborn person, and I know many others are as well, but believe me when I tell you that nobody is going to out-stubborn a computer. If you are having a persistent problem and everything that you have tried isn't working, try to think of something else you haven't tried. Change tracks. Clear your mind for a while and then try to think of a totally different possible explanation for what you are seeing. You may discover what the problem is this way.

Keep an Open Mind

Very often the real cause of the problem you are seeing is the last thing that you can possibly think would be it; problems simply are not always cause-and-effect. Keep in mind the famous quote of Sherlock Holmes (Sir Arthur Conan Doyle): "When you have eliminated the impossible, whatever remains, however improbable, must be the truth". It is very common for a symptom to be the result of a problem in a completely different part of the PC, which is why you need to make sure that you fully explore the problem before looking for a solution. In addition, bear in mind that changes to a system usually are the cause of problems that arise shortly thereafter, even if they are in unrelated areas.

Give Yourself Time

Starting a troubleshooting session on a difficult problem one half-hour before you have to go away for the weekend is not a great idea. Since you haven't allowed yourself nearly enough time to do a proper job of diagnosing the situation, you are going to feel rushed. It's likely that you will misdiagnose the problem, have to stop half-way before you are finished, and that you will generally feel uncomfortable during the entire process (even more than usual).

Give yourself a fighting chance to resolve the problem properly by allowing yourself enough time to do the job right.

Be Wary of Fatigue

Problem-solving, which is what troubleshooting is at its core, requires concentration. Concentration is hard to hold when you are feeling tired. If you start to feel fatigued, you may be much better off to call it a night and try again the next day, unless there is a rush to get the problem addressed for some reason. (While you are taking this rest, as well, your subconscious mind may even help to solve the problem for you.)

A fresh look after a good night's rest has been enough to solve a problem that seemed "unresolvable" the night before more than once for me.

If You're Stuck, Try Using Your "Background Processing Capabilities"

An amazing capability of the human brain is that under certain circumstances you can put your own subconscious to work for you, to help you solve a problem without expending any energy at all. I am no expert in the field of psychology, but I have used this technique myself with great success on many occasions.

Have you ever tried to remember something, some detail of a past conversation, or a phone number of an old friend, and felt that you knew it but just couldn't remember the exact words or numbers you were looking for? And then a few hours or a day or two later the answer will "pop into your mind" apparently for no reason, while you are doing something else? This is what I am talking about, and sometimes it can help you to resolve problems with your machine.

Some day, you may have a particularly difficult problem that you have been trying to solve for quite a while. It may seem that the answer is obvious, yet you can't quite grasp it. If this is the case, try just going on and doing something else temporarily. Take your conscious mind off the task at hand and try to do something enjoyable, relaxing or distracting for a few hours or the rest of the night. Let your subconscious work on the problem "in the background".

Then come back the next day and look at the problem again. You may find it much easier to resolve the problem now--I've even had the answer come to me in a matter of minutes after spending the previous entire day trying to figure it out. You may even find the answer popping into your head while doing something completely unrelated.

Two Heads are Better Than One

If you have at your disposal someone who knows about PCs, say a peer in your office or a family member, have them take a look at a difficult problem. Even if you are great at troubleshooting, there will be the occasional problem that for one reason or another, you just won't be able to crack. Sometimes another person who can look at a problem from a fresh perspective (who hasn't been staring at the same thing for days trying to resolve it) will be able to set you on the right path to fixing the problem.

Don't be afraid of asking for help. There is no shame in needing assistance, and it can be an excellent way to learn.

It Isn't Personal...

OK, this section hits me very close to home. Before you take umbrage at any of the comments that I make here, I will start by saying that I am one of the worst people I know in doing all of the things that I say in this section one should not do. :^) I have a pretty bad temper and tend to take things too seriously in general, so it's not surprising that I tend to lose it sometimes when I am stuck with a particularly enigmatic situation with a PC.

What I am saying here is that despite the fact that it may seem otherwise when you are feeling frustrating about some sort of difficulty, the PC is not doing whatever it is doing intentionally to annoy you. It is not alive, it has no feelings, no motivations, no agenda. There is a logical reason for everything that a PC does--it is just hard sometimes to understand what it is. It can seem like the PC is "out to get you", and then to start feeling very frustrated and angry. Usually when this happens your ability to actually solve the problem will drop pretty close to zero.

During the throes of particularly frustrating spells, I personally have at various times yelled at PCs, kicked PC case covers, slammed the desk with my fist, crunched up floppy disks in my hands, smashed keyboards, smacked the side of a monitor, and hit the power switch rather hard more than once. As a result of this foolishness, I have on rare occasion damaged a component or two, and even hurt my hands. This is one area where I definitely do not recommend that my readers follow my example. :^)

Try as much as possible to keep your cool when working on your machine. If you feel yourself getting really pissed off, this is likely a good signal that you've been working on the problem too long. Take a break, do something else for a while. A fresh look the next day will be better for both you and the PC.

Let the Vendor Do the Work!

You may not have to use the troubleshooting information on this site at all. If the system is exhibiting strange behavior, especially if it appears that it has any failed or failing components, and you purchased this system recently, you may want to just return it and let the vendor figure out what the problem is. In many cases this is the best thing to do when your PC is still under warranty, since this also eliminates any chance of you voiding the warranty, and saves you time as well. That's what a warranty is for. See here for information on using your warranty, and repair in general.

The problem with doing this is that you have to incur the hassle of bringing the PC back for service. If the PC was purchased mail order, the problem is even worse. Sometimes looking on the site first is a good idea anyway, to rule out any possible simple causes that you can address yourself.

http://www.oininteractive.com/tutorials/health-and-safety-pc-repair/

COMPUTER SOFTWARE AND ITS USES

System software (systems software) is computer software designed to operate and control the computer hardware and to provide a platform for running application software.
http://en.wikipedia.org/wiki/System_software

A ***system software*** is the backbone of a computer. On one hand, it regulates the operation of the computer hardware to perform the necessary user-oriented functions, and on the other, it also provides the basic framework to enable smooth running of the various application software. To put it simply, it is the basic platform upon which the computer runs its hardware and enables the user to derive full computing functionality of the various application software and get his work done. Now, speaking of the types of system software, there are four basic categories under which the classification can be done.

These are:-

- The **Basic Input Output System** (BIOS) or boot loader, which defines the firmware interface and loads the OS;
- The **device firmware** that controls the operation and performance of the computer hardware;
- The **operating system** (OS) which allows the user to interact with the hardware and get the desired outcome by carrying data between RAM and storage disks, displaying the desired result on the output device (monitor/LCD) and by acting as the platform to allow various other system and application software to run on the computing device;
- Various **utility software** that regulate the computer functionality by analyzing its performance, configuring and optimizing its processes and thereby, carrying out system maintenance functions.

Different Types of System Software Programs

A **system software** is a collection of software programs that enable the user to interact with the computing device without getting lost among the complexities of technical interactions between mechanical parts and machine-oriented codified programs. These programs are the building blocks that construct the entire system software architecture including the parts that regulate input/output functions, those that provide application software platforms and the various different types of operating system software component programs.

Boot Firmware: Also known as boot loaders, these programs are the first ones to run when a PC is started. A boot loader loads and runs the main operating system on the computer when it starts. This component is also known as BIOS on IBM compatible computing devices.

Database Management Systems: This is a set of programs that manage and regulate the user database right from creation to maintenance and extending to the use of such database. The DBMS is responsible for allowing different user applications to access a single database at the same time. This set of programs is what lies at the base of all computer network models that enable users to retrieve data from an integrated collection in a structured manner and does away with the user having to write complex programs in machine language to extract information from the data pool.

Output Interface: This program determines whether the desktop environment will be in the form of a character user interface (CUI as seen on DOS and older OS versions) or if it will be in the form of a graphical user interface (GUI as seen from latest OS, a norm made common by Windows). Also, besides determining the desktop environment, these programs also provide various options that allow the user to access other features of the OS from the desktop.

Virtual Machine Monitors: Also known as hypervisors, these programs allow multiple operating systems to run on a single host computer system simultaneously. These other computer systems that access the host are known as guests and the host is able to allow multiple operating systems to run simultaneously under the hardware virtualization process.

Link Editors: Commonly known as linkers, link editors collect multiple object files that the compiler programs, generate, and put them together as an executable program, which is capable of performing desired tasks as instructed by codified instructions.

Loaders: A loader is an inbuilt component of the operating system that loads programs onto the computer memory and makes them ready for execution. This process involves loading the program text from the executable file onto the computer memory and preparing the executable file to run. This is one of the various initial stages involved in running any program on the operating system.

Shell: Shells are programs that make the interaction between the kernel of the OS and the user possible. It is the outer layer of a computing interface that makes information interchange between the OS and the user possible.

Utility Software: These programs offer the various maintenance and performance evaluation utility tools to configure and optimize the various processes that influence the performance of your computer. Disk cleaners, anti-virus software, data compression programs, disk drive partition utilities, storage, backup and archiving programs, etc., are some of the common examples of utility software.

http://www.buzzle.com/articles/types-of-system-software.html

The ***operating system*** (prominent examples being Microsoft Windows, Mac OS X and Linux), allows the parts of a computer to work together by performing tasks like transferring data between memory and disks or rendering output onto a display device. It also provides a platform to run high-level system software and application software.

A kernel is the core part of the operating system that defines an API for applications programs (including some system software) and an interface to device drivers.

In computing, the ***kernel*** is a computer program that manages input/output requests from software and translates them into data processing instructions for the central processing unit and other electronic components of a computer. The kernel is a fundamental part of a modern computer's operating system.

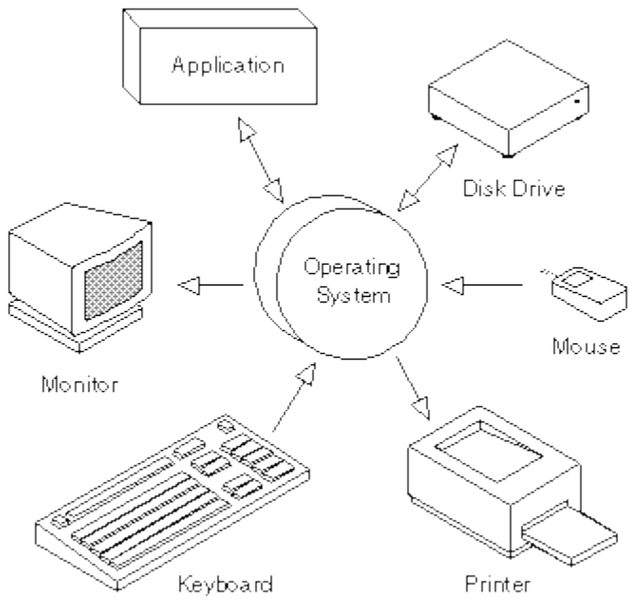
Device drivers such as computer BIOS and device firmware provide basic functionality to operate and control the hardware connected to or built into the computer.

Utility software helps to analyze, configure, optimize and maintain the computer

THE OPERATING SYSTEM
http://www.webopedia.com/TERM/O/operating_system.html

The operating system is the most important program that runs on a computer. Every general-purpose computer must have an operating system to run other programs. Operating systems perform basic tasks, such as recognizing input from the keyboard, sending output to the display screen, keeping track of files and directories on the disk, and controlling peripheral devices such as disk drives and printers.

For large systems, the operating system has even greater responsibilities and powers. It is like a traffic cop -- it makes sure that different programs and users running at the same time do not interfere with each other. The operating system is also responsible for security, ensuring that unauthorized users do not access the system.



Classification of Operating systems

- Multi-user: Allows two or more users to run programs at the same time. Some operating systems permit hundreds or even thousands of concurrent users.
- Multiprocessing : Supports running a program on more than one CPU.
- Multitasking : Allows more than one program to run concurrently.
- Multithreading : Allows different parts of a single program to run concurrently.
- Real time: Responds to input instantly. General-purpose operating systems, such as DOS and UNIX, are not real-time.

Operating systems provide a software platform on top of which other programs, called application programs, can run. The application programs must be written to run on top of a particular operating system. Your choice of operating system, therefore, determines to a great extent the applications you can run. For

PCs, the most popular operating systems are DOS, OS/2, and Windows, but others are available, such as Linux.

As a user, you normally interact with the operating system through a set of commands. For example, the DOS operating system contains commands such as COPY and RENAME for copying files and changing the names of files, respectively. The commands are accepted and executed by a part of the operating system called the command processor or command line interpreter. Graphical user interfaces allow you to enter commands by pointing and clicking at objects that appear on the screen.

The Linux open source operating system, or Linux OS, is a freely distributable, cross-platform operating system based on Unix that can be installed on PCs, laptops, netbooks, mobile and tablet devices, video game consoles, servers, supercomputers and more.

The Linux OS is frequently packaged as a Linux distribution for both desktop and server use, and includes the Linux kernel (the core of the operating system) as well as supporting tools and libraries. Popular Linux OS distributions include Debian, Ubuntu, Fedora, Red Hat and openSUSE.

UNIX
Pronounced yoo-niks, a popular multi-user, multitasking operating system developed at Bell Labs in the early 1970s. Created by just a handful of programmers, UNIX was designed to be a small, flexible system used exclusively by programmers.

UNIX was one of the first operating systems to be written in a high-level programming language, namely C. This meant that it could be installed on virtually any computer for which a C compiler existed. This natural portability combined with its low price made it a popular choice among universities. (It was inexpensive because antitrust regulations prohibited Bell Labs from marketing it as a full-scale product.)

Bell Labs distributed the operating system in its source language form, so anyone who obtained a copy could modify and customize it for his own purposes. By the end of the 1970s, dozens of different versions of UNIX were running at various sites.

Due to its portability, flexibility, and power, UNIX has become a leading operating system for workstations. Historically, it has been less popular in the personal computer market.

Today, the trademarked "Unix" and the "Single UNIX Specification" interface are owned by The Open Group. An operating system that is certified by The Open Group to use the UNIX trademark conforms to the Single UNIX Specification.

Application Software – the kind of software that people use to perform a general purpose task, such as word processing software used to prepare the text for document, desktop publishing or payroll processing.

Types of Application Software

a. **Customized software** – software designed for a particular customer. A software develop by a computer programmer or software developer to suit the needs of the customer.
b. **Packaged software** – is the kind of “off-the-shelf” program developed for sale to the general public. Examples are word processing and spreadsheet programs or the Microsoft Office Package.

Example of Packaged Application Software:

a. Word Processor
b. Spreadsheet Software
c. Presentation Software
d. Database Software
e. Desktop Publishing Software

A. Word Processors – are usually the first application that leads people to using a computer for their work. These normally have the following capabilities built into them.

1. spell checking
2. standard layouts for normal documents
3. ability to have some characters appear in bold print, italics, or underlined.
4. center lines, make text line up on the left side of the paper, or the right side of the paper.
5. save the document so it can be used again,
6. print the document.

Examples of Word Processing Software:

1. Microsoft Word ’97, 2000, XP, 2003, 2007, 2010 and 2013
2. Word Perfect
3. Lotus WordPro

B. Spreadsheet Software – commonly used for accounting purposes such as:

1. tabulating of complex mathematical equations with a row and column matrix.
2. designed to used number and formulas to do calculations with ease.

Examples of Spreadsheet Software:

a. Microsoft Excel ’97, 2000, XP, 2003, 2007, 2010 and 2013
b. Lotus 123
c. Quicken

C. Database Software – programs that manage large amounts of data organized as fields, records and files.

Examples of Database Software:

a. Microsoft Access 2000, 2003, 2007, 2010 and 2013
b. Lotus Approach

D. Presentation Software – designed to showcase information to an audience. Used extensively in business to display graphics, charts, diagrams, photos, and text blocks to highlight information.

Examples of Presentation Software:

a. Microsoft PowerPoint ’97, 2000, XP, 2003, 2007, 2010 and 2013
b. Lotus Freelance Graphics

E. Multimedia Software: Allows users to create image, audio, video etc. Example: Real Player, Media Player etc.

WHAT IS UTILITY SOFTWARE:

In computers, a utility is a small program that provides an addition to the capabilities provided by the operating system. In some usages, a utility is a special and nonessential part of the operating system. The print "utility" that comes with the operating system is an example. It's not absolutely required to run programs and, if it didn't come with the operating system, you could perhaps add it. In other usages, a utility is an application that is very specialized and relatively limited in capability. A good example is a search-and-replace utility. Some operating systems provide a limited capability to do a search-and-replace for given character strings. You can add a much more capable search-and-replace utility that runs as an application program. However, compared to a word processor, a search-and-replace utility has limited capability.

Types of utility software

Software that helps the computer run better and perform house keeping tasks. There are many different types of utility software and this list is hardly complete, but here are some of the main categories:

- Virus detection and protection programs
- Compression software
- System diagnostics software
- Peripheral utilities & drivers
- Networking utilities
- Internet utilities

Some software doesn’t fit easily into any one category. Firewall utilities fit into both the virus protection and networking categories.

Virus detection and protection programs

Programs are available to protect your system from damage caused by other programs such as viruses. Virus detection and protection utilities perform this task.

Compression software

(For example, WinZip, WinRar and 7Zip)

Software that enables files to be stored in less space on a disk. Compressed files also take less time to transfer across a network.

System diagnostics software

(For example, Norton Systemworks Pro 2003)
Software that monitors how your computer is performing. Running this sort of software may inform you of the imminent failure of any hardware before it occurs.

Peripheral utilities and drivers

(For example, Winfax Pro 10.0)
Specialist programs that enable your computer to communicate with certain devices like faxes, OCR devices, scanners, etc.

Networking utilities

(For example, LapLink 2003)
Utilities that enhance the operation of a computer network. Some of these utilities are necessary and not just enhancements. The network may need these utilities to run. Some other of the common types of networking utilities are…

- Remote access software (for example, Laplink 2003)
- Terminal emulation software (for example, Reflection X MS 32 bit 8.0 english)
- Security software (for example, Norton Internet Security 2001 2.1)
- TCP-IP software (for example, PC/TCP Network Software 5.0)

Internet utilities

- Web browsers (for example, Netscape /Internet Explorer/Opera)
- Email (for example, Netscape Messenger)
- Web effects packages (for example, Dreamweaver Ultradev)
- Web page editors (for example, Frontpage, MX Studio)
- Plug ins and helper applications (for example, Realplayer Plus)

Installed software Vs. Web-Based Software:

Installed Software: Software you buy from market or download from the Internet to your computer. The software is physically installed in your computer and runs from your Hard Drive. Usually these kinds of software are wrapped inside a CD case when you buy it from market. Example: MS Office, Games etc.

Web Based Software: Software that are run from the Internet. Example: Online games, Virus protection software that you download from Internet etc.

Software Suites: Related software programs are sometimes sold bundled together as a software suite. Example: MS Office. When you purchase MS Office license you basically purchase the right to install and use MS Word, MS Excel, Power Point, and FrontPage.

Types of Software According to Ownership and Rights

Commercial Software: Installation in number of computers is specified by the software vendor/producer. User only buys the license to use it. User does not buy the software. He/she may not be allowed to install a software more than one machine.
A demo version of software may exist for free but demo version does not include all the key components of the software.

Retail software: This type of software is sold off the shelves of retail stores. It includes expensive packaging designed to catch the eye of shoppers and, as such, is generally more expensive. An advantage of retail software is that it comes with printed manuals and installation instructions, missing in hard-copy form from virtually every other category of software. However, when hard-copy manuals and instructions are not required, a downloadable version off the Internet will be less expensive, if available.

OEM software: OEM stands for "Original Equipment Manufacturer" and refers to software sold in bulk to resellers, designed to be bundled with hardware. For example, Microsoft has contracts with various companies including Dell Computers, Toshiba, Gateway and others. Microsoft sells its operating systems as OEM software at a reduced price, minus retail packaging, manuals and installation instructions. Resellers install the operating system before systems are sold and the OEM CD is supplied to the buyer. The "manual" consists of the Help menu built into the software itself. OEM software is not legal to buy unbundled from its original hardware system.

Shareware: This software is downloadable from the Internet. Licenses differ, but commonly the user is allowed to try the program for free, for a period stipulated in the license, usually thirty days. At the end of the trial period, the software must be purchased or uninstalled. Some shareware incorporates an internal clock that disables the program after the trial period unless a serial number is supplied. Other shareware designs continue to work with "nag" screens, encouraging the user to purchase the program.

Crippleware: This software is similar to shareware except that key features will cease to work after the trial period has ended. For example, the "save" function, the print function, or some other vital feature necessary to use the program effectively may become unusable. This "cripples" the program. Other types of crippleware incorporate crippled functions throughout the trial period. A purchase is necessary to unlock the crippled features.

Demo software: Demo software is not intended to be a functioning program, though it may allow partial functioning. It is mainly designed to *demonstrate* what a purchased version is capable of doing, and often works more like an automated tutorial. If a person wants to use the program, they must buy a fully functioning version.

Adware: This is free software that is supported by advertisements built into the program itself. Some adware requires a live Internet feed and uses constant bandwidth to upload new advertisements. The user must view these ads in the interface of the program. Disabling the ads is against the license agreement. Adware is not particularly popular.

Spyware: Spyware software is normally free, but can be shareware. It clandestinely "phones home" and sends data back to the creator of the spyware, most often without the user's knowledge. For example, a multimedia player might profile what music and video files the software is called upon to play. This information can be stored with a unique identification tag associated with the specific program on a user's machine, mapping a one-to-one relationship. The concept of spyware is very unpopular, and many programs that use spyware protocols were forced to disclose this to users and offer a means to turn off reporting functions. Other spyware programs divulge the protocols in their licenses, and make acceptance of the spyware feature a condition of agreement for using the software.

Freeware: Freeware is also downloadable off the Internet and free of charge. Often freeware is only free for personal use, while commercial use requires a paid license. Freeware does not contain spyware or adware. If it is found to contain either of these, it is reclassified as such.

Public domain software: This is free software, but unlike freeware, public domain software does not have a specific copyright owner or license restrictions. It is the only software that can be legally modified by the user for his or her own purposes.

SOFTWARE EXAMPLES ACCORDING TO CATEGORIES

- **Audio & Multimedia**
  - Audio Encoders/Decoders
  - Audio File Players
  - Audio File Recorders
  - CD Burners
  - CD Players
  - Multimedia Creation Tools
  - Music Composers
- Other
- Presentation Tools
- Rippers & Converters
- Speech
- Video Tools

- **Business**
  - Accounting & Finance
  - Calculators & Converters
  - Databases & Tools
  - Helpdesk & Remote PC
  - Inventory & Barcoding
  - Investment Tools
  - Math & Scientific Tools
  - Office Suites & Tools
  - Other
  - PIMS & Calendars
  - Project Management
  - Vertical Market Apps
- **Communications**
  - Chat & Instant Messaging
  - Dial Up & Connection Tools
  - E-Mail Clients
  - E-Mail List Management
  - Fax Tools
  - Newsgroup Clients
  - Other Comms Tools
  - Other E-Mail Tools
  - Pager Tools
  - Telephony
  - Web/Video Cams
- **Desktop**
  - Clocks & Alarms
  - Cursors & Fonts
  - Icons
  - Other
  - Themes & Wallpaper
- **Development**
  - Active X
  - Basic, VB, VB DotNet
  - C / C++ / C#
  - Compilers & Interpreters
  - Components & Libraries
  - Debugging
  - Delphi
  - Help Tools
  - Install & Setup
  - Management & Distribution
  - Other
  - Source Editors
- **Education**
  - Computer
  - Dictionaries
  - Geography
  - Kids
  - Languages
  - Mathematics
  - Other
  - Reference Tools
  - Science
  - Teaching & Training Tools
- **Games & Entertainment**
  - Action
  - Adventure & Roleplay
  - Arcade
  - Board
  - Card
  - Kids
  - Online Gaming
  - Other
  - Puzzle & Word Games
  - Simulation
  - Sports
  - Strategy & War Games
  - Tools & Editors
- **Graphic Apps**
  - Animation Tools
  - CAD
  - Converters & Optimizers
  - Editors
  - Font Tools
  - Gallery & Cataloging Tools
  - Icon Tools
  - Other
  - Screen Capture
  - Viewers
- **Home & Hobby**
  - Astrology/Biorhythms/Mystic
  - Astronomy
  - Cataloging
  - Food & Drink
  - Genealogy
  - Health & Nutrition

- Other
- Personal Finance
- Personal Interest
- Recreation
- Religion

- **Network & Internet**
  - Ad Blockers
  - Browser Tools
  - Browsers
  - Download Managers
  - File Sharing/Peer to Peer
  - FTP Clients
  - Network Monitoring
  - Other
  - Remote Computing
  - Search/Lookup Tools
  - Terminal & Telnet Clients
  - Timers & Time Synch
  - Trace & Ping Tools

- **Security & Privacy**
  - Access Control
  - Anti-Spam & Anti-Spy Tools
  - Anti-Virus Tools
  - Covert Surveillance
  - Encryption Tools
  - Other
  - Password Managers

- **Servers**
  - Firewall & Proxy Servers
  - FTP Servers
  - Mail Servers
  - News Servers
  - Other Server Applications
  - Telnet Servers
  - Web Servers

- **System Utilities**
  - Automation Tools
  - Backup & Restore
  - Benchmarking
  - Clipboard Tools
  - File & Disk Management
  - File Compression
  - Launchers & Task Managers
  - Other
  - Printer
  - Registry Tools
  - Shell Tools
  - System Maintenance
  - Text/Document Editors

- **Web Development**
  - ASP & PHP
  - E-Commerce
  - Flash Tools
  - HTML Tools
  - Java & JavaScript
  - Log Analysers
  - Other
  - Site Administration
  - Wizards & Components
  - XML/CSS Tools

BASIC COMPUTER PARTS

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, OS X, Microsoft Office, Solitaire, Google Chrome, Adobe Acrobat Reader, and WordPerfect are examples of software.

Without software that allows the hardware to accomplish something, a computer is nothing 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 DOS, Windows XP, Windows Vista, Windows 7, OS X, and various types of Unix, such as Red Hat and Mandrake.

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 98. The same printer requires a different device driver when using Windows XP. Each piece of installed hardware requires a device driver for the operating system being used. Figure 1.1 shows how hardware and software must work together.

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) that must be accessed by the application.

Firmware combines hardware and software into important chips inside the computer. It is called firmware because it is a chip, which is hardware, and it has software built into the chip. An example of firmware is the BIOS (basic input/output system) chip. BIOS chips always have

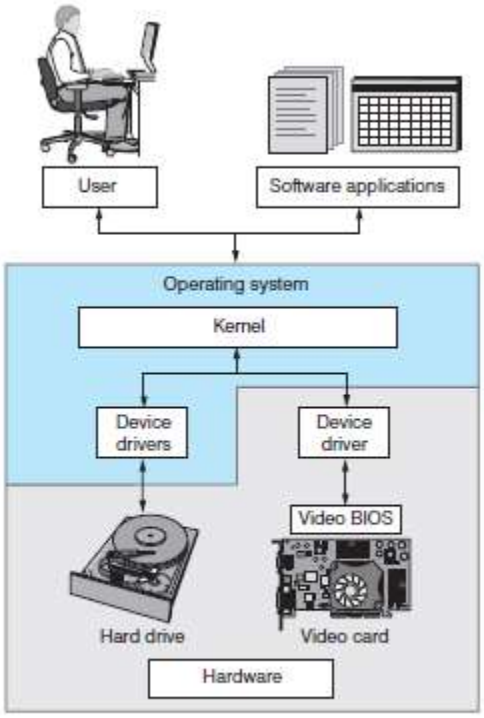


Figure 1.1 Hardware and software

software inside them. The BIOS has startup software 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.

The simplest place to start to learn about computer repair is with the hardware components and their common names. A **computer**, sometimes called a microcomputer or a PC, is a unit that performs tasks using software applications. Computers/PC come in three basic models: (1) a **desktop** model that normally sits on top of a desk; (2) a **tower** model that sits under a desk; and (3) a **laptop** model, which is portable. Laptops are sometimes called notebooks; smaller versions are called netbooks or nettops. A fourth type of computer is a **handheld computer** or palmtop computer. These replaced the PDA (personal digital assistant). The palmtype computer is normally incorporated into a cell phone.

A computer consists of a case (chassis), **a keyboard** that allows users to provide input into the computer, a **monitor** that displays information, and a **mouse** that allows data input or is used to select menus and options. Figure 1.3 shows a tower computer case, monitor, keyboard, and mouse.

Once the case is removed from the computer, 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 the case. A power cord goes from the power supply to a wall outlet or surge strip. One purpose of the power supply is to convert the AC voltage that comes out of the outlet to DC voltage the computer can use. The power supply also supplies DC voltage to the internal parts of the computer. A fan located inside the power supply keeps the computer cool, which avoids damage to the components.

Figure 1.3 Tower computer

A computer usually has a device to store software applications and files. Two examples of storage devices are the floppy drive and the hard drive. A slot in the front of the computer easily identifies the floppy drive. **The floppy drive** allows data storage to floppy disks (sometimes called diskettes or disks) that can be used in other computers. Floppy disks store less information than hard drives. The **hard drive**, sometimes called hard disk, is a rectangular box normally inside the computer's case that is sealed to keep out dust and dirt. In a desktop computer, the hard drive is

normally mounted below or beside the floppy drive. A **CD drive** holds disks (CDs) that have data, music, or software applications on them. A popular alternative to a CD drive is a **DVD drive** (digital versatile disk drive), which supports CDs as well as music and video DVDs.

The **motherboard** is the main circuit board located 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 systemboard. The motherboard is the largest electronic circuit board in the computer. The keyboard frequently connects directly to the back of the motherboard, although some computers have a keyboard connection in the front of the case. Figure 1.4 shows a different view of a tower computer with a hard drive, floppy drive, power supply, motherboard, and DVD drive. Notice that the floppy drive has a slot in the front of the computer, whereas the hard drive does not.

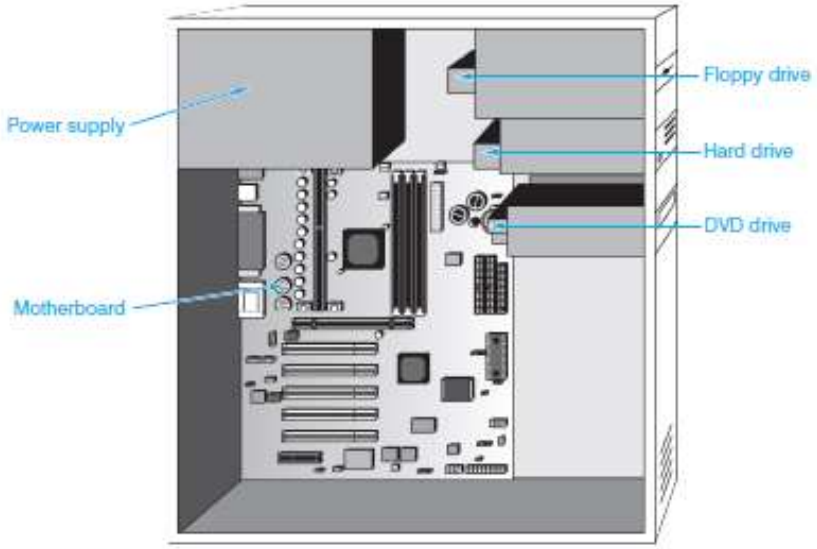


Figure 1.4 Tower computer with hard drive, floppy drive, power supply, motherboard, and DVD drive

Some devices have a cable that connects the device to the motherboard. Other devices require an adapter. **Adapters** are electronic circuit cards that normally plug into an **expansion slot on** the motherboard. Other names for an adapter are controller, card, controller card, circuit card, circuit board, and adapter board. The number of available expansion slots on the motherboard depends on the manufacturer.

An adapter may control multiple devices such as the DVD drive and speakers. An alternative to an adapter plugging directly into the motherboard is the use of a riser board. A **riser board** plugs into the motherboard and has its own expansion slots. Adapters can plug into these expansion slots instead of directly into the motherboard. Figure 1.5 is an illustration of a riser board and one adapter.

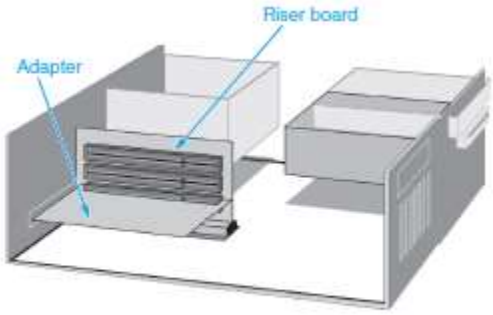


Figure 1.5 Microcomputer with a riser board and one adapter

A laptop has similar parts to a tower or desktop computer, but they are smaller. Portable computers (laptops) normally use a battery as their power source, but they can have an AC connection. Laptop batteries are normally modules that have one or two release latches that are used to remove the module. Figure 1.6 shows common laptop parts.

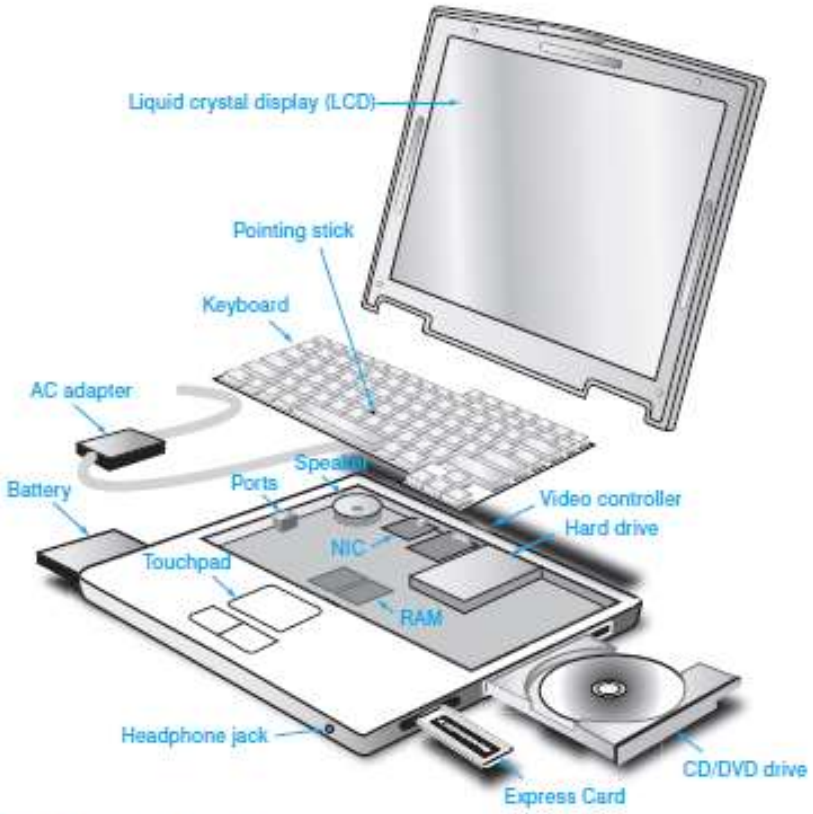


Figure 1.6 Laptop battery

When the laptop has the AC adapter attached, the battery is being recharged on most models. The laptop AC adapter converts the AC from the wall outlet to DC, which the laptop needs. Figure 1.7 shows the laptop port to which the AC adapter connects. The port sometimes has a DC voltage symbol below or beside it. This symbol is a solid line with a dashed line below it.

Laptops sometimes have one or more media bays to install removable drives such as a CD/DVD drive. A latch on the bottom of the laptop normally releases the drive. The bays allow hot swapping (device can be inserted with the power applied), but it is always safer to shut down the computer before installing a device unless you are sure it is hot swappable. Figure 1.8 shows the more commonly seen built-in CD/DVD drive.

Memory is an important part of any computer. Memory chips hold applications, part of the operating system, and user documents. Two basic types of memory are **RAM** and **ROM**. **RAM** (random access memory) is volatile memory meaning the data inside the chips is lost when power to the computer is shut off. 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 a disk or the hard drive, the document is lost because the information does not stay in RAM when power is shut off.

Figure 1.8 Laptop media bay

ROM (read-only memory) is nonvolatile memory because data stays inside the chip even when the computer is turned off. ROM chips are sometimes installed on adapters such as a network or video card.

RAM and ROM chips come in different styles: **DIP** (Dual In-line Package), **DIMM** (Dual Inline Memory Module), and RIMM (a memory module developed by Rambus). RAM chips can be any of the types, but they are usually DIMMs. Some ROM chips are DIP chips. They are usually distinguishable by a sticker that shows the manufacturer, version, and date produced. Memory chips are covered in great detail in Chapter 6 on memory. See Figure 1.9 for an illustration of a motherboard, various expansion slots, memory, and an adapter in an expansion slot.

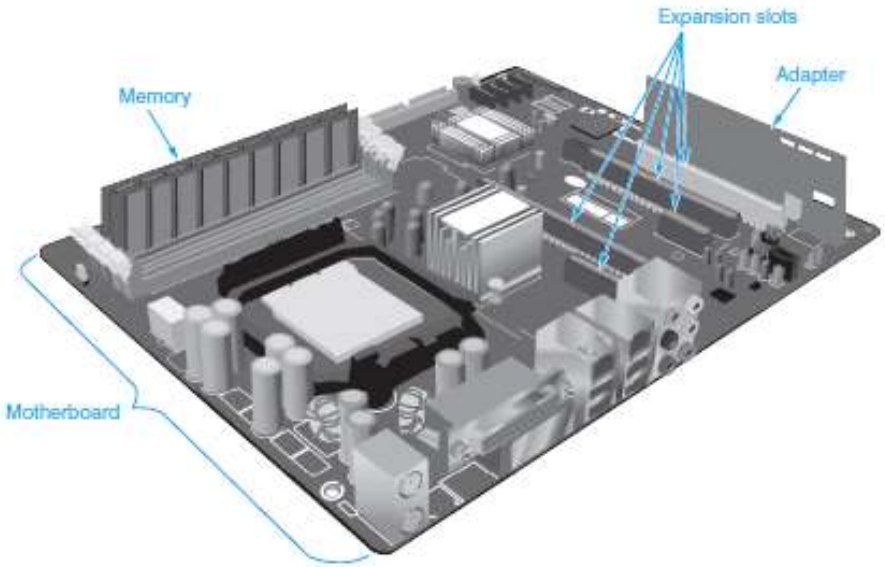


Figure 1.9 Motherboard with expansion slots and adapter

Part of the startup software the motherboard BIOS contains is **POST** (power on self test). POST performs a basic test of the individual hardware components such as the motherboard, RAM memory chips, keyboard, floppy drive, and hard drive. When a computer is turned on with the power switch, BIOS executes POST. Numbers appearing in the upper-left corner of the monitor indicate that POST is checking RAM. Turning the computer on with the power switch is known as a **cold boot.** Users perform a cold boot every time they power on their computers. A technician performs a cold boot when he or she is troubleshooting a computer and needs POST to execute. You can restart a Windows XP computer with a warm boot by clicking the Start button,

clicking Shut Down, selecting Restart from the drop-down menu, and clicking the OK button. It can also be performed by holding down the CTRL key, the ALT key, and the DEL key at the same time, selecting Task Manager, selecting the Shut Down option, selecting Restart from the dropdown menu, and clicking the OK button. Warm booting causes any changes that have been made to take effect without putting as much strain on the computer as a cold boot does. In Vista/7, click on the right arrow adjacent to the lock button and select Restart or press Ctrl+Alt+Del, select the up arrow in bottom right corner, and choose Restart from the menu.

External Connectivity

A **port** is a connector on the motherboard or on a separate adapter that allows a device to connect to the computer. Sometimes a motherboard has ports built directly into the motherboard. Motherboards that have ports built into them are called **integrated motherboards**. A technician must be able to identify these common ports readily to ensure that (1) the correct cable plugs into the port; and (2) the technician can troubleshoot problems in the right area.
Many port connections are referred to as male or female. **Male ports** have metal pins that protrude from the connector. A male port requires a cable with a female connector. **Female ports** have holes in the connector into which the male cable pins are inserted.

Many connectors on integrated motherboards are either D-shell connectors or DIN connectors. A **D-shell connector** has more pins or holes on top than on the bottom, so a cable connected to the D-shell connector can only be inserted in one direction and not accidentally flipped upside down. Parallel, serial, and video ports are examples of D-shell connectors. Many documents represent a D-shell connector by using the letters DB, a hyphen, and the number of pins—for example, DB-9, DB-15, or DB-25.

A **DIN connector** is round with small holes and is normally keyed. When a connector is keyed it has an extra metal piece or notch that matches with an extra metal piece or notch on the cable, and the cable can only be inserted into the DIN connector one way. Older keyboard and mouse connectors are examples of DIN connectors. Today, keyboard and mouse connectors can also be USB connectors. These are covered later in the chapter. Figure 1.10 shows the back of a computer with an integrated motherboard. There are various DIN and D-shell connectors on the motherboard.

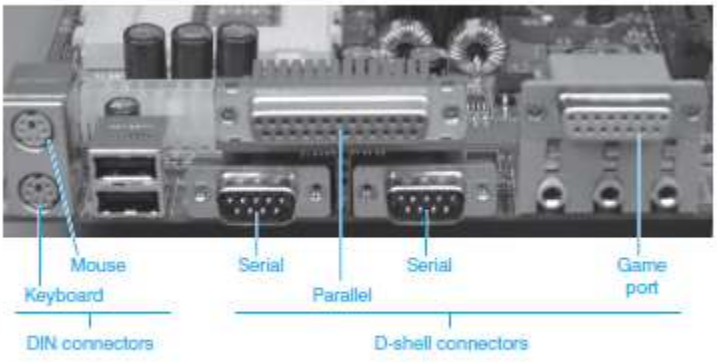


Figure 1.10 DIN and D-Shell connectors

Video Port

A **video port** is used to connect a monitor. Today, there are two types normally seen and they both have three rows. The older one is a three-row, 15-pin female D-shell. The 15-pin female connector is used to attach VGA, SVGA, XGA, SXGA, or UXGA monitors. These monitors have a CRT (cathode ray tube) and are heavier and bulkier than a flat panel monitor. Even though it can have

different types of monitors attached, it is normally referred to as a **VGA port**. The newer port is called a **DVI port** (Digital Visual Interface) and it has three rows of square holes. This is the newer video port and is used to connect flat panel digital monitors. Flat panel monitors can also use the older VGA port. There are actually different types of DVI ports. They are covered in more detail in Chapter 9 on video. Some video adapters also allow you to connect a video device (such as a television) that has an S-Video port. Figure 1.11 shows a video adapter with all three ports. The top port is for S-Video, the center port is the DVI connector, and the bottom port is a VGA port.

Figure 1.11 Video ports

USB Port

USB stands for Universal Serial Bus. A **USB port** allows up to 127 devices to transmit at speeds up to 5Gbps (5 billion bits per second) with version 3.0. Compare these speeds to parallel port transfers of 1Mbps (1 million bits per second). Devices that can connect to the USB port include printers, scanners, mice, keyboards, joysticks, CD drives, DVD drives, tape drives, floppy drives, flight yokes, cameras, modems, speakers, telephones, video phones, data gloves, and digitizers. In order for the computer to use the USB port, it must have a Pentium or higher CPU; an operating system that supports USB, such as Windows 9x or higher, Apple OS X, or *nix (any flavor of Unix) and a chipset that acts as a host controller. Additional ports can sometimes be found on the front of computer cases. Figure 1.12 shows a close-up view of two USB ports. Figure 1.13 is a photograph of computer USB ports.

Figure 1.12 USB ports

Figure 1.13 USB ports on the front of a computer

USB ports and devices come in three versions—1.0, 2.0, and 3.0. Version 1.0 supported speeds of 1.5Mbps and 12Mbps. Version 2.0 increased the supported speed to 480Mbps; and Version 3.0 supports speeds up to 5Gbps. A symbol that looks like a trident is sometimes seen on the USB port or on the USB cable. A plus sign above one prong identifies a Version 2.0 port, but not all manufacturers use this symbol. Version 3.0 is sometimes referred to as SuperSpeed USB, and the logo has two S's on it. Figure 1.14 shows the USB symbols.

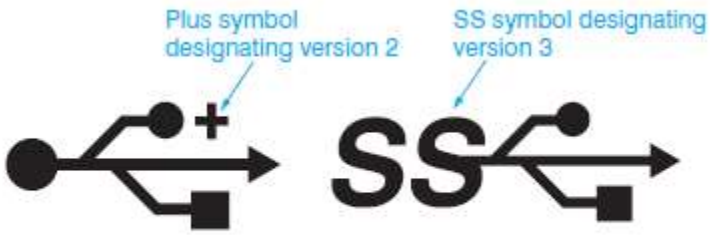


Figure 1.14 USB symbols

Converters are available to convert a USB port to a different type of connector (or vice versa), such as serial, parallel, PS/2 mouse/keyboard, or mini-DIN. Figure 1.15 shows a converter that inserts into a PS/2 mini-DIN connector and allows a USB mouse or keyboard to be connected.

Figure 1.15 Mini-DIN to USB converter

A smaller USB port used on small devices such as a USB hub, PDA, digital camera, and phones is known as a mini-USB port. There are three types of mini-USB ports: mini-A, mini-B, and mini-AB. The mini-AB port accepts either a mini-A or a mini-B cable end. The two leftmost connectors shown in Figure 1.16 are mini-B and standard A USB connectors. (The three connectors shown on the right are 6-, 4-, and 9-pin IEEE 1394 connectors, which are discussed later in this chapter.)

Figure 1.16 Mini-B and a standard A USB connectors (as well as IEEE 1394 connectors)

DIN - A **DIN** connector is an electrical connector that was originally standardized by the Deutsches Institut für Normung (DIN), the German national standards organization.

IEEE - **Institute of Electrical and Electronics Engineers** (IEEE) is a professional association with its corporate office in New York City. Its objectives are the educational and technical advancement of electrical and electronic engineering, telecommunications, computer engineering and allied disciplines.

Parallel Port

The **parallel port** is a 25-pin female D-shell connector used to connect a printer to the computer. Some motherboards have a small picture of a printer etched over the connector. Parallel ports transfer eight bits of data at a time to the printer or any other parallel device connected to the parallel port. Other parallel devices include tape drives, Iomega's Zip drive, scanners, and external hard drives. Parallel ports are becoming obsolete due to USB ports. Refer to Figure 1.10 for a photo of a parallel port.

Serial Port

A **serial port** (also known as a COM port, RS-232 port, or an asynchronous (async) port) can be a 9-pin male D-shell connector or a 25-pin male D-shell connector (on very old computers). Serial ports are used for a variety of devices including mice, external modems, digitizers, printers, PDAs, and digital cameras. Serial ports are becoming obsolete for the same reason that parallel ports are—USB ports. The most common reason to have a serial port would be for an external modem. The serial port transmits one bit at a time and is much slower than the parallel port that transmits eight bits at a time. Serial ports sometimes have a small picture of two rows of square blocks (two digital square waves) tied together etched over the connector. The other type of picture sometimes shown above a serial port is a series of 1s and 0s. Figure 1.17 shows both types of markings. Figure 1.18 shows a USB to serial port converter if a serial port is needed and only USB ports are available. A converter may be purchased to convert a USB port to almost any other type of port.

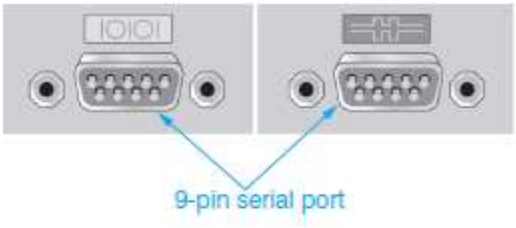


Figure 1.17 Serial port markings

Figure 1.18 USB to serial port converter

Serial and parallel ports are typically bidirectional, which means that data transfers to/from the port to the motherboard/adapter in both directions. Video, keyboard, and mouse ports are typically unidirectional. The mouse and keyboard are normally input-only devices, so data flows from the device to the computer. The monitor is normally an output device, and data flows from the computer to the monitor.

Mouse and Keyboard Ports

Mouse and **keyboard ports** have traditionally been 6-pin mini-DIN connectors, but some computer manufacturers are using USB ports to connect mice or keyboards. The mini-DIN port is sometimes called a PS/2 port. Refer to Figure 1.10 to see the mouse and keyboard ports. Most manufacturers color code the mouse and keyboard ports and/or put a small diagram of a keyboard and a mouse on the connectors.

Normal mouse use typically causes its internal parts to become dirty. Before explaining how to clean a mouse, understanding the basic internal mouse workings is important because the topics are interrelated. There are two basic types of mice—mechanical and optical. A **mechanical mouse** uses a rubber ball inserted into the bottom of the mouse. The rubber ball turns small metal, rubber, or plastic rollers mounted on the sides. The rollers relay the mouse movement to the computer. On the other hand, an **optical mouse** has optical sensors that detect the direction in which the mouse ball moves. It uses reflections from LEDs using a grid pattern mouse pad or almost any surface to detect mouse location.

A trackball is a replacement for the mouse. It sits in one location and does not move around on a mouse pad or desk. Instead, a person uses his or her palm to move the mouse pointer by means of a ball that rolls on bearings located inside the device.

Keyboards are input devices that connect to the keyboard port. There are two main types of keyboards: mechanical and capacitive. **Mechanical keyboards** are the cheapest and most common type. They use a switch that closes when a key is depressed. When the switch gets dirty, it sticks. Mechanical keyboards require more cleaning and are more error-prone than their capacitive counterparts. A **capacitive keyboard** is more reliable and more expensive than a mechanical keyboard because of the electronics involved in the design.

Wireless Input Devices

Many input devices have cordless connectivity. Two common devices are the keyboard and mouse. There are two types of technologies used with wireless input devices: infrared and radio. Whichever one is used, a transceiver is connected to a serial, PS/2 mouse/keyboard, or USB port. Infrared is used for shorter distances and is cheaper than the radio method. However, infrared devices must be kept within the line of sight of the transceiver (the device that picks up the wireless signal that attaches to the computer) and this can be umbersome. Radio controlled wireless devices can have interference from other devices in the home or office such as microwave ovens, cordless phones, and other wireless devices (see Figure 1.19).

Figure 1.19 Wireless devices

Sound Card Ports

A **sound card** converts digital computer signals to sound and sound to digital computer signals. A sound card is sometimes called an audio card and can be integrated into the motherboard or an adapter that contains several ports. The most common ports include a port for a microphone, one or more ports for speakers, and an input port for a joystick or **MIDI** (musical instrument digital interface) device. Examples of MIDI devices include electronic keyboards and external sound modules. The joystick port is sometimes known as a **game port**. Game ports are 15-pin female D-shell connectors, and are sometimes confused with older Ethernet connectors. Game ports are becoming extinct because of the popularity of USB ports. Another type of digital sound port that is gaining popularity is **S/PDIF** (Sony/Philips Digital Interface). There are two main types of S/PDIF connectors: an RCA jack used to connect a coaxial cable and a fiber-optic port for a TOSLINK cable connection. Sound cards, however, are still popular because people want better sound than what is available integrated into a motherboard. See Figure 1.21 for an illustration of a sound card. Figure 1.29 later in the chapter shows the S/PDIF ports.

Table 1.1 Common input devices

Device	Description
digital pen	Translates words written with the pen for input into the computer. The pen can also be used to control the cursor or mouse. The pen is frequently a wireless device and is sometimes used with a digital tablet.
digital tablet	Allows graphical or desktop publishing information to be input. The tablet can be wireless or connected to a USB or serial port. A tablet can come with an integrated mouse and/or digital pen. This is sometimes called a drawing tablet.
signature pad	Allows someone to sign and digitally store his or her name.
touch screen	Allows a finger or a pen-like device to control a special monitor. The screens are popular with bank ATMs and with kiosks such as those found in schools, hotels, and shopping malls.
track pad	Allows the pointer to be manipulated with fingertip movement by means of an integrated window or a place located on a laptop. Flat buttons that are similar to mouse control buttons are mounted above or below the track pad.
trackball	Allows a user to use the palm or fingertip to move the pointer on the screen. This is achieved by manipulating a device that has a ball mounted in the center.
TrackPoint (by IBM) or **track stick**	Controls pointer operations as an alternative to a mouse by means of a rubber nipple that is normally situated between keys in the center of the laptop keyboard.

Figure 1.20 Digital tablet

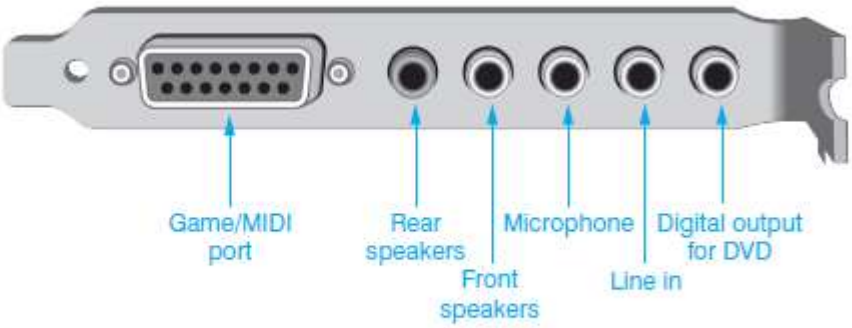


Figure 1.21 Sound card ports

IEEE 1394 Port

The IEEE 1394 standard is a serial technology developed by Apple Computer. Sometimes it is known as FireWire or i.Link, which is a Sony trademark. **IEEE 1394** ports have been more predominant on Apple computers, but are now becoming a standard port on PCs. Windows and Apple operating systems support the IEEE 1394 standard. Many digital products now have an integrated IEEE 1394 port for connecting to a computer. IEEE 1394 devices include camcorders, cameras, printers, storage devices, DVD players, CD-R drives, CD-RW drives, tape drives, film readers, speakers, and scanners.

Speeds supported are 100, 200, 400, 800, 1200, 1600, and 3200Mbps. As many as 63 devices (using cable lengths up to 14 feet) can be connected with FireWire. The IEEE 1394 standard supports hot swapping (plugging and unplugging devices with the power on), plug and play, and powering low-power devices. The cable has six wires—four for data and two for power. Newer IEEE 1394 standards support the use of RJ-45 and fiber connectors. Figure 1.22 shows FireWire ports. Figure 1.23 shows three IEEE 1394 adapter ports.

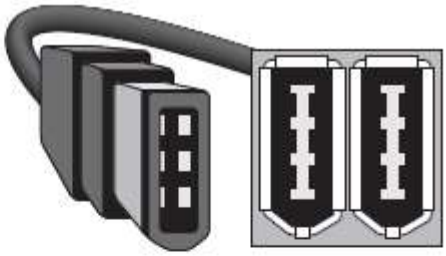


Figure 1.22 FireWire ports

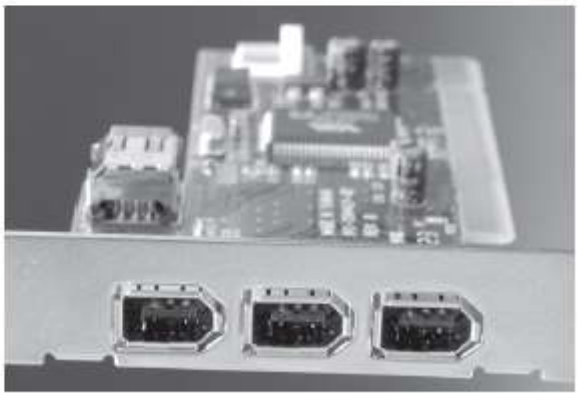


Figure 1.23 IEEE 1394 adapter ports

The Basic Set of Computer Repair Tools

http://www.bookfresh.com/resources/article/the-basic-set-of-computer-repair-tools/

It's always good to have a few computer repair tools around. If you're running a computer repair business, or even if you're just a casual computer user who likes keeping thins well-maintained, having a good toolkit handy will definitely pay off. You never know when something might go wrong with your system, so think of computer repair tools as a sort of insurance policy should your hardware go haywire.

The Essentials

As with any toolkit, every set of computer repair tools requires certain essential pieces. So long as you have these basic tools, you can pretty much solve most of your hardware problems.

◦**Wire Stripper**
A lot of times, the problem is in the wiring. Since you're going to be fiddling around with your computer's wires, you're going to need something to take their insulators off. It'll be much easier to bypass any wire damage this way.

◦**Screwdrivers**
When you're in the middle of repairing your computer, you're bound to notice that it takes quite a number of differently-sized screws to hold it all together. That's why every computer repair kit should have a good set of screwdrivers. You'll find that those six-piece sets of precision screwdrivers will do

the trick for smaller screws, while a standard-sized Phillips-head and a standard slotted-head screwdriver should be adequate for the larger ones.

◦**Grips**
You're also going to need tools that help you grip the various parts of your computer. Pliers and mini-wrenches (roughly 5mm to 11mm) should be more than enough to help you out.

◦**Extension Bars**
You'll notice that repairing your computer will involve a lot of hard-to-reach places. There are a lot of nooks and crannies that will be hard to work around. For example, you may find screws that need loosening in the inner corners of your CPU's frame. Getting extension bars for your tools will make things a lot easier for you.

◦**Soldering Kit**
There will often come a point where some soldering is in order. Because of this, every good computer repair toolkit needs its own soldering set. The set should include the basics of soldering: a soldering stand, a soldering iron, a soldering gun, a solder core, a heat sink, a de-soldering pump, and some soldering wire.

◦**Micro-part Management Tools**
This is a lot less technical than it sounds. Basically, you'll need some tools that will help you manage the smaller parts of your computer. There can be screws that are so tiny, you're better off using a pair of tweezers to pick them up. Other tools that will help in this respect are a magnifying glass, and an easy-to-spot container to keep your micro-parts organized.

◦**Boot Disks**
Of course, not all repairs are hardware-based. Sometimes, you'll need to re-install the operating system of the computer. Make sure to keep boot disks of the major operating systems handy.

◦**Anti-Malware Tools**
Lastly, every good kit for computer repairs should have software to detect and eliminate any infections from viruses, spyware, and other malware.

A **screwdriver** is a tool, manual or powered, for turning (driving or removing) screws. A typical simple screwdriver has a handle and a shaft, and a tip that the user inserts into the screw head to turn it. The shaft is usually made of tough steel to resist bending or twisting. The tip may be hardened to resist wear, treated with a dark tip coating for improved visual contrast between tip and screw—or ridged or treated for additional 'grip'. Handle are typically wood, metal, or plastic and usually hexagonal, square, or oval in cross-section to improve grip and prevent the tool from rolling when set down.

Blade types
The tool used to drive a slotted screw head is called a flat-blade, slot-head, straight, flat, flat-tip, or "flat-head" screwdriver. This last usage can be confusing, because the term flat-head also describes a screw with a flat top, designed to install in a countersunk hole. Such a flat-headed screw may have a slotted, cross, square recessed, or combination head.

Phillips screwdrivers come in several standard sizes, ranging from tiny "jeweler's" to those used for automobile frame assembly—or #00 to #3 respectively. This size number is usually stamped onto the shank (shaft) or handle for identification. Each bit size fits a range of screw sizes, more or less well.

Variations

Torque screwdrivers
A torque screwdriver is a screwdriver with components that ensure tightening to a specified torque, ensuring tightening which is sufficient, but not excessive. An insufficiently tightened screw connection may loosen in operation, and excessive tightening can damage parts; for example, if the nuts holding the wheel of a car in place are too loose, or damaged by overtightening, a wheel may come off at speed. Torque screwdrivers are used in mechanical production, manufacturing, and maintenance; their use is part of quality assurance.


Manual torque screwdriver with torx bit

Powered screwdrivers

Interchangeable bits allow the use of powered screwdrivers, commonly using an electric or air motor to rotate the bit. Cordless drills with speed and torque control are commonly used as power screwdrivers.

An auto-feed, battery-powered screwdriver


A rechargeable battery-powered electric screwdriver.

Ratcheting screwdrivers

Some manual screwdrivers have a ratchet action whereby the screwdriver blade locks to the handle for clockwise rotation, but uncouples for counterclockwise rotation when set for tightening screws—and vice versa for loosening.

Torque, moment or moment of force (see the terminology below) is the tendency of a force to rotate an object about an axis,[1] fulcrum, or pivot. Just as a force is a push or a pull, a torque can be thought of as a twist to an object. Mathematically, torque is defined as the cross product of the lever-arm distance vector and the force vector, which tends to produce rotation.

A **multimeter or a multitester,** also known as a VOM (Volt-Ohm meter), is an electronic measuring instrument that combines several measurement functions in one unit. A typical multimeter would include basic features such as the ability to measure voltage, current, and resistance. Analog multimeters use a microammeter whose pointer moves over a scale calibrated for all the different measurements that can be made. Digital multimeters (DMM, DVOM) display the measured value in numerals, and may also display a bar of a length proportional to the quantity being measured. Digital multimeters are now far more common than analog ones, but analog multimeters are still preferable in some cases, for example when monitoring a rapidly varying value.

Stripper Crimpers

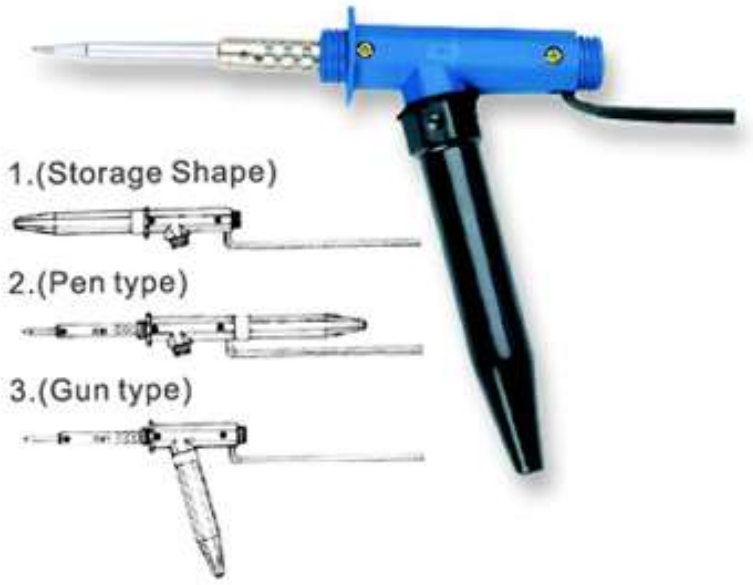
Crimping is joining two pieces of metal or other ductile material by deforming one or both of them to hold the other. The bend or deformity is called the crimp.

A wire stripper is a small, hand-held device used to strip the electrical insulation from electric wires.

Crimping pliers are devices used to crush small metal objects and wiring to create a crimp, a firm closure or join that will not open back up on its own. Crimps are used in beading, electrical wiring, and many other applications. Hardware stores usually stock crimping pliers and they also can be ordered directly through supply catalogs. One advantage of catalog orders is that people can be assured they are ordering a product designed for the task at hand.

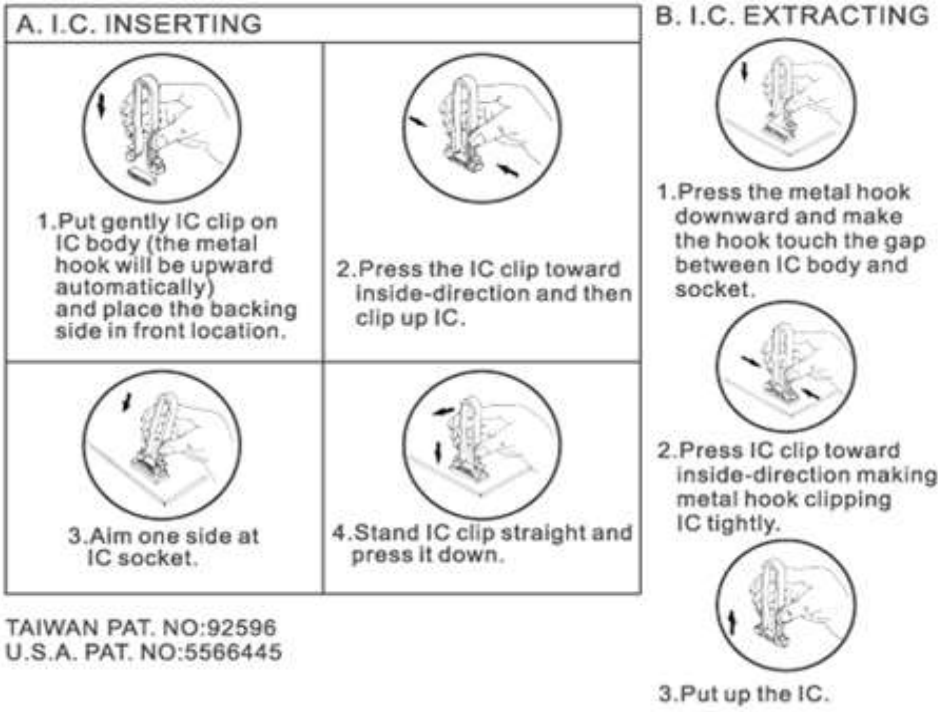
Soldering and Desoldering

Soldering is a process in which two or more metal items are joined together by melting and flowing a filler metal (solder) into the joint, the filler metal having a lower melting point than the adjoining metal. Soldering differs from welding in that soldering does not involve melting the work pieces. In brazing, the filler metal melts at a higher temperature, but the work piece metal does not melt. In the past, nearly all solders contained lead, but environmental concerns have increasingly dictated use of lead-free alloys for electronics and plumbing purposes.



Desoldering a contact from a wire

I.C. Inserter and Extractor



Pliers and Cutters

Pliers are a hand tool used to hold objects firmly, possibly developed from tongs used to handle hot metal in Bronze Age Europe.[1] They are also useful for bending and compressing a wide range of materials. Generally, pliers consist of a pair of metal first-class levers joined at a fulcrum positioned closer to one end of the levers, creating short jaws on one side of the fulcrum, and longer handles on the other side.

Slip joint pliers

Diagonal pliers or side cutters

Lineman's pliers or combination pliers

Needle-nose pliers

Pincers

Electrical wire stripping and terminal crimping pliers

Crimptool for N, R-SMA, TNC connectors for RG174, RG58 and HDF/LMR200

Heavy duty crimping pliers that have interchangeable RJ heads

Hand crimp tool

Hand crimp tool for insulated terminals and non-insulated terminals; also has a wire cutter and stripper and screw cutters

Tongue-and-groove pliers

Locking pliers

Circlip pliers, for fitting and removing retaining rings

Round-nose pliers, for making loops in wire

Anti-Static Wrist Strap

An antistatic wrist strap with crocodile clip.

An antistatic wrist strap, ESD wrist strap, or ground bracelet is an antistatic device used to safely ground a person working on very sensitive electronic equipment, to prevent the buildup of static electricity on their body, which can result in electrostatic discharge (ESD). It is used in the electronics industry by workers working on electronic devices which can be damaged by ESD, and also sometimes by people working around explosives, to prevent electric sparks which could set off an explosion. It consists of a stretchy band of fabric with fine conductive fibers woven into it, attached to a wire with a clip on the end to connect it to a ground conductor. The fibers are usually made of carbon or carbon-filled rubber, and the strap is bound with a stainless steel clasp or plate. They are usually used in conjunction with an antistatic mat on the workbench, or a special static-dissipating plastic laminate on the workbench surface.

The wrist strap is usually worn on the nondominant hand (the left wrist for a right-handed person). It is connected to ground through a coiled retractable cable and 1 megohm resistor, which allows high-voltage charges to leak through but prevents a shock hazard when working with low-voltage parts. Where higher voltages are present, extra resistance (0.75 megohm per 250 V) is added in the path to ground to protect the wearer from excessive currents; this typically takes the form of a 4 megohm resistor in the coiled cable (or, more usually, a 2 megohm resistor at each end).

Cleaning Tools

Toolkit

Brush

Vacuum cleaner

Cleaning the computer and its components

Cleaning your computer, components, and peripherals helps keep everything in good working condition and helps prevent germs from spreading. The picture shows a good example of just how dirty the inside of your computer case can get. In this example, it is obvious that all the dust and dirt is going to prevent proper air flow and may even prevent the fan from working.

How often should I clean my computer?

The frequency of how often you should clean your computer varies on different factors. To help you determine how often you need to clean your computer we created the checklist below. Check each of the boxes below that apply to your computers conditions to help determine how often you should clean the computer.

Where is computer located?	
In a home environment	☐
In a clean office environment	☐
In construction or industry environment	☐
In school environment	☐
Computer environment	
Have cat or dog in same building as computer	☐
Smoke in same building as computer	☐
Smoke next to computer	☐

Computer is on floor	☐
Room that the computer is in has carpet	☐
Eat or drink by computer	☐
Who uses it?	
Adult (18 and older)	☐
Young adults (ages 10-18) use computer	☐
Pre-teen (younger than 10) use computer	☐
More than one person uses computer	☐

With what is checked above, clean your computer every 11 months.

General cleaning Tips

Below is a listing of suggestions to follow when cleaning any computer components or peripherals as well as tips to help keep a computer clean.

1. Never spray or squirt any liquid onto any computer component. If a spray is needed, spray the liquid onto a cloth.
2. You can use a vacuum to suck up dirt, dust, or hair around the computer. However, **do not** use a vacuum inside your computer as it generates static electricity that can damage your computer. If you need to use a vacuum inside your computer, use a portable battery powered vacuum or try compressed air.
3. When cleaning a component or the computer, turn it off before cleaning.
4. Be cautious when using any cleaning solvents; some people have allergic reactions to chemicals in cleaning solvents and some solvents can even damage the case. Try always to use water or a highly diluted solvent.
5. When cleaning, be careful to not accidentally adjust any knobs or controls. Also, when cleaning the back of the computer, if anything is connected make sure not to disconnect the plugs.
6. When cleaning fans, especially smaller fans, hold the fan or place something in-between the fan blades to prevent it from spinning. Spraying compressed air into a fan or cleaning a fan with a vacuum may cause damage or generate back voltage.
7. Never eat or drink around the computer.
8. Limit smoking around the computer.

Preventive Maintenance

A computer should be cleaned at least once a year in a normal working environment. A computer runs longer and more efficiently if preventive maintenance is periodically undertaken.
Preventive maintenance includes certain procedures performed to prolong the life of the computer. Some computer companies sell maintenance contracts that include a preventive maintenance program. Typical preventive measures include vacuuming the computer and cleaning the floppy drive heads, CD/DVD laser, keyboard keys, printers, and monitor screen.

Cleaning tools

Although computer cleaning products are available you can also use household items to clean your computers and peripherals. Below is a listing of items you may need or want to use while cleaning your computer.

- **Cloth** - A cotton cloth is the best tool used when rubbing down computer components. Paper towels can be used with most hardware, but we always recommend using a cloth whenever possible. However, only use a cloth when cleaning components such as the case, a drive, mouse, and keyboard. You should not use a cloth to clean any circuitry such as the RAM or motherboard.
- **Water or rubbing alcohol** - When moistening a cloth, it is best to use water or rubbing alcohol. Other solvents may be bad for the plastics used with your computer.
- **Portable Vacuum** - Sucking the dust, dirt, hair, cigarette particles, and other particles out of a computer can be one of the best methods of cleaning a computer. However, do not use a vacuum that plugs into the wall since it creates lots of static electricity that can damage your computer.
- **Cotton swabs** - Cotton swaps moistened with rubbing alcohol or water are excellent tools for wiping hard to reach areas in your keyboard, mouse, and other locations.
- **Foam swabs** - Whenever possible, it is better to use lint-free swabs such as foam swabs.

Case cleaning

Why? Keeps the appearance of the computer looking new. While cleaning, if you see ventilation slots, these can be cleaned or cleared to help keep a steady airflow into the computer and keep all components cool.

Procedure: The plastic case that houses the PC components can be cleaned with a slightly damp lint-free cloth. For stubborn stains, add a little household detergent to the cloth. You should not use a solvent cleaner on plastics.

Make sure all vents and air holes are hair and lint free by rubbing a cloth over the holes and vents. It is also helpful to take a vacuum around each of the hole, vents, and crevices on the computer. It is safe to use a standard vacuum when cleaning the outside vents of a computer.

CD-ROM, DVD, and other disc drive cleaning

Why? A dirty CD-ROM drive or other disc drives can cause read errors when reading discs. These read errors could cause software installation issues or issues while running the program.

Procedure: To clean the CD-ROM drive we recommend purchasing a CD-ROM cleaner from your local retailer. Using a CD-ROM cleaner should sufficiently clean the CD-ROM laser from dust, dirt, and hair.

In addition to cleaning the drive with a special disc designed to clean drives, you can also use a cloth dampened with water to clean the tray that ejects from the drive. However, make sure that after the tray is cleaned that it completely dry before putting the tray back into the drive.

CD and DVD disc cleaning

Why? Dirty CDs can cause read errors or cause CDs to not work at all.

Procedure: Use a cleaning kit or damp clean cotton cloth to clean CDs, DVDs, and other discs When cleaning a disc wipe against the tracks, starting from the middle of the CD or DVD and wiping towards the outer side as shown in the picture below. Never wipe with the tracks; doing so may put more scratches on the disc.

Tip: If the substance on a CD cannot be removed using water, pure alcohol can also be used.

Headphones cleaning

Why? Headphones used by many different people may need to be frequently cleaned to help prevent the spreading of germs and head lice.

Procedure: If the headphones being used are plastic or vinyl, moisten a cloth with warm water and rub the head and earpieces of the headphones. If the headphones are being used for a library or school do not use any disinfectant or cleaning solvent since some people can have allergic reactions to the chemicals they contain.

Headphones that have cushions also have the availability of having the cushions replaced. Replacing these cushions can also help keep the headphones clean.

Finally, in regards to headphones spreading head lice. If many different students use the same headphones, consider having the students using their own headphones, placing bags over the headphones, or using headphones that can be wiped with warm water after each use.

Keyboard cleaning

These steps are for cleaning a desktop keyboard.

Dust, dirt, and bacteria
The computer keyboard is usually the most germ infected items in your home or office, it may even contain more bacteria than your toilet seat. Cleaning it helps remove any dangerous bacteria and keeps the keyboard working properly.

Procedure: Before cleaning the keyboard first turn off the computer or if you are using a USB keyboard unplug it. Not unplugging the keyboard can cause other computer problems as you may press keys that cause the computer to perform a task you do not want it to do.

Many people clean the keyboard by turning it upside down and shaking. A more efficient method is to use compressed air. Compressed air is pressurized air contained in a can with a very long nozzle. aim the air between the keys and blow away all of the dust and debris that has gathered there. A vacuum cleaner can also be used, but make sure the keyboard does not have loose "pop off" keys can be sucked up by the vacuum.

If you want to clean the keyboard more extensively remove the keys from the keyboard.
After the dust, dirt, and hair has been removed. Spray a disinfectant onto a cloth or use disinfectant cloths and rub each of the keys on the keyboard. As mentioned in our general cleaning tips, never spray any liquid onto the keyboard.

Substance spilt into the keyboard

If the keyboard has anything spilt into it (e.g. pop, cola, Pepsi, Coke, beer, wine, coffee, and milk), not taking the proper steps can destroy the keyboard.

Procedure: Below are a few recommendations that can help prevent a keyboard from becoming bad after something has spilt into the keys.

If anything is spilt onto the keyboard turn the computer off immediately or at the very least disconnect the keyboard from the computer. Once done flip the keyboard over to prevent the substance from penetrating circuits. While the keyboard is upside down, shake the keyboard over a surface that can be cleaned later. While still upside down, use a cloth to start cleaning the keys. After cleaned leave the keyboard upside down for at least one night allowing it to dry. Once dry, continue cleaning the keyboard with any remaining substance.

If after cleaning the keyboard you have keys that stick remove the keys and clean below the keys and the bottom portion of the key.

Finally, if the keyboard still works but remains dirty or sticky before discarding the keyboard as a last resort try washing the keyboard in the dishwasher.

If after doing all the above steps the keyboard still does not work we recommend buying a new keyboard.

LCD cleaning

Why? Dirt, dust, and fingerprints can cause the computer screen to be difficult to read.

Procedure: Unlike a computer monitor, the LCD or flat-panel display is not glass and requires special cleaning procedures.

When cleaning the LCD screen it is important to remember to not spray any liquids onto the LCD directly, press gently while cleaning, and do not use a paper towel since it scratches the LCD.

To clean the LCD screen use a non-rugged microfiber cloth, soft cotton cloth, or Swiffer duster. If a dry cloth does not completely clean the screen, you can apply rubbing alcohol to the cloth and wipe the screen with a damp cloth. Rubbing alcohol is used to clean the LCD before it leaves the factory.

Mouse cleaning

Why? A dirty optical-mechanical mouse (mouse with a ball) can cause the mouse to be difficult to move as well as cause strange mouse movement.

Procedure: To clean the rollers of an optical-mechanical mouse, you must first remove the bottom cover of the mouse. To do this, examine the bottom of the mouse to see what direction to rotate the

cover. As you can see in the below illustration, the mouse cover must be moved counter clockwise. Place two fingers on the mouse cover and push the direction of the arrows.

Once the cover has rotated about an inch, rotate the mouse into its normal position, covering the bottom of the mouse with one hand and the bottom should fall off including the mouse ball. If the cover does not fall off try shaking the mouse gently.

Once the bottom cover and the ball is removed, you should be able to see three rollers located within the mouse. Use a cotton swab, finger, or fingernail to remove any substance. Usually, there is a small line of hair and dirt in the middle of the roller, remove as much as this substance as possible. Once you have removed as much dirt and hair as possible, set the ball back within the mouse and place the cover back on.

If the mouse still has the same problems repeat the above process. If after several attempts the mouse is still having the same problems your mouse has other hardware issues and should be replaced.

Note: Cleaning your mouse pad with a damp cloth can also help improve a computer's mouse movement.

Why? To help keep the mouse clean and germ free it can be helpful to clean the mouse.

Procedure: Use a cloth moistened with rubbing alcohol or warm water and rub the surface of the mouse and each of its buttons.

Printer cleaning

Why? Cleaning the outside of a printer can help keep the printer's appearance looking good and if used by many different people keep the printer clean of germs.

Procedure: First, make sure to turn off the printer before cleaning it. Dampen a cloth with water or rubbing alcohol and wipe the case and each of the buttons or knobs on the printer. As mentioned earlier, never spray any liquid directly onto the printer.

Why? Some printers require the inside to be cleaned to help keep the printer running smoothly.

Disassembly Overview

It is seldom necessary to completely disassemble a computer. However, when a technician is first learning about PCs, disassembly can be both informative and fun. Technicians might disassemble parts of a computer to perform preventive cleaning or to troubleshoot a problem. It may also be appropriate to disassemble a computer when it has a problem of undetermined cause. Sometimes, the only way to diagnose a problem is to disassemble the computer outside the case or remove components one by one. Disassembling the computer outside the case may help with grounding problems. A grounding problem occurs when the motherboard or adapter is not properly installed and a trace (metal line on the motherboard or adapter) touches the computer frame, causing the adapter and possibly other components to stop working.

Electrostatic Discharge (ESD)

Many precautions must be taken when disassembling a computer. The electronic circuits located on the motherboard and adapters are subject to ESD. ESD (electrostatic discharge) is a difference of potential between two items that causes static electricity. Static electricity can damage electronic equipment without the technician’s knowledge. The average person requires a static discharge of 3,000 volts before he or she feels it. An electronic component can be damaged with

as little as 30 volts. Some electronic components may not be damaged the first time static electricity occurs. However, the effects of static electricity can be cumulative, weakening or eventually destroying a component. An ESD event is not recoverable—nothing can be done about the damage it induces. Electronic chips and memory modules are most susceptible to ESD strikes. Atmospheric conditions affect static electricity. When humidity is low, the potential for ESD is greater than at any other time. Keep humidity above 50 percent to reduce the threat of ESD. A technician can prevent ESD by using a variety of methods. The most common tactic is to use an antistatic wrist strap. One end encircles the technician's wrist. At the other end, an alligator clip attaches to the computer. The clip attaches to a grounding post or a metal part such as the power supply. The electronic symbol for ground follows:

An antistatic wrist strap allows the technician and the computer to be at the same voltage potential. As long as the technician and the computer or electronic part are at the same potential, static electricity does not occur.

A resistor inside the wrist strap protects the technician in case something accidentally touches the ground to which the strap attaches while he or she is working inside a computer. This resistor cannot protect the technician against the possible voltages inside a monitor.

When not to wear an antistatic wrist strap
Technicians should not wear an ESD wrist strap when working inside a CRT monitor because of the high voltages there.

Antistatic bags are good for storing spare adapters and motherboards when the parts are not in use. However, antistatic bags are not as effective after a few years. Antistatic mats are available to place underneath a computer being repaired; many of the mats have a snap for connecting the antistatic wrist strap. Antistatic heel straps are also available.

If an antistatic wrist strap is not available, you can still reduce the chance of ESD damage. After removing the computer case, if you are right-handed, place your bare left arm on the power supply. Remove the computer parts one by one, always keeping your left elbow (or some bare part of your arm) connected to the power supply. If you are left-handed, place your right arm on the power supply. By placing your elbow on the power supply, both hands are free to remove computer parts. This method is an effective way of keeping the technician and the computer at the same voltage potential, thus reducing the chance of ESD damage. It is not as safe as using an antistatic wrist strap. Also, removing the power cable from the back of the computer is a good idea. Power supplies provide a small amount of power to the motherboard even when the computer is powered off. Always unplug the computer and use an antistatic wrist strap when removing or replacing parts inside the computer!

EMI (Electromagnetic Interference)

EMI (electromagnetic interference, sometimes called EMR for electromagnetic radiation) is noise caused by electrical devices. Many devices can cause EMI, such as a computer, pencil sharpener, motor, vacuum cleaner, air conditioner, and fluorescent lighting. The electrical devices around the computer case, including the CRT-type monitor and speakers, cause more problems than the computer.

A specific type of electromagnetic interference that affects computers is **RFI** (radio frequency interference). RFI is simply those noises that occur in the radio frequency range. Anytime a computer has an intermittent problem, check the surrounding devices for the source of that problem. For example, if the computer only goes down when the pencil sharpener operates or when using the CD/DVD player, then EMI could be to blame. EMI problems are very hard to track to the source. Any electronic device including computers and printers can be a source of

EMI/RFI. EMI/RFI can affect any electronic circuit. EMI can also come through power lines. Move the computer to a different wall outlet or to a totally different circuit to determine if the power outlet is the problem source. EMI can also affect files on a hard drive.

Replace empty slot covers
To help with EMI and RFI problems, replace slot covers for expansion slots that are no longer being used. Slot covers also keep out dust and improve the airflow within the case.

Disassembly

Before a technician disassembles a computer, several steps should be performed or considered. The following list is helpful:

- Do not remove the motherboard battery or the configuration information in CMOS will be lost.
- Use proper grounding procedures to prevent ESD damage.
- Keep paper and pen nearby for note taking and diagramming. Even if you have taken computers apart for years, you might find something unique or different inside.
- Have ample workspace.
- When removing adapters, do not stack the adapters on top of one another.
- If possible, place removed adapters inside a special ESD protective bag.
- Handle each adapter or motherboard on the side edges. Avoid touching the gold contacts on the bottom of adapters. Sweat, oil, and dirt cause problems.
- Hard disk drives require careful handling. A very small jolt can cause damage to stored data.
- You can remove a power supply, but do not disassemble a CRT-style monitor or power supply without proper training and tools.

Tools

No chapter on disassembly and reassembly is complete without mentioning tools. Tools can be divided into two categories: (1) do not leave the office without and (2) nice to have in the office, home, or car.

Many technicians do not go on a repair call with a full tool case. Ninety-five percent of all repairs are completed with the following basic tools:

- Medium flat-tipped screwdriver
- Small flat-tipped tweaker screwdriver
- #1 Phillips screwdriver
- #2 Phillips screwdriver
- 1/4-inch nut driver
- 3/16-inch nut driver
- Pair of small diagonal cutters
- Pair of needlenose pliers

Screwdrivers take care of most disassemblies and reassemblies. Sometimes manufacturers place tie wraps on new parts, new cables, or the cables inside the computer case. The diagonal cutters are great for removing the tie wraps without cutting cables or damaging parts. Needlenose pliers are good for getting disks or disk parts out of disk drives, straightening bent pins on cables or connectors, and doing a million other things. Small tweaker screwdrivers and needlenose pliers are indispensable.

Do not use magnetized screwdrivers
Avoid using a magnetic screwdriver. It can cause permanent loss of data on hard or floppy disks. Magnetism can also induce currents into components and damage them. Sometimes, technicians are tempted to use a magnetic screwdriver when they drop a small part such as a screw into a hard-to-reach place or when something rolls under the motherboard. It is best to avoid using a magnetic screwdriver when working inside a computer.

Alternatives to the magnetic screwdriver include a screw pick-up tool and common sense. The screw pick-up tool is used in the hard-to-reach places and sometimes under the motherboard. If a screw rolls under the motherboard and cannot be reached, tilt the computer so that the screw rolls out. Sometimes the case must be tilted in different directions until the screw becomes dislodged. There are tools that no one thinks of as tools, but which should be taken on a service call every time. They include: a pen or pencil with which to take notes and fill out the repair slip and a bootable disc containing the technician's favorite repair utilities. Usually a technician has several bootable disks or CDs for different operating systems and utilities. Often a flashlight comes in handy because some rooms and offices are dimly lit. Finally, do not forget to bring a smile and a sense of humor.

Tools that are nice to have, but not used daily, include the following:

- Multimeter
- Screw pick-up tool
- Screwdriver extension tool
- Soldering iron, solder, and flux
- Screw-starter tool
- Medium-size diagonal cutters
- Metric nut drivers
- Cable-making tools
- AC circuit tester
- Right-angled, flat-tipped, and Phillips screwdrivers
- Hemostats
- Pliers
- CD/DVD cleaning kit
- Network cable tester
- Nonstatic vacuum
- Disposable gloves

You could get some nice muscle tone from carrying all of these nice to have, but normally unnecessary tools. When starting out in computer repair, get the basics. As your career path and skill level grow, so will your toolkit. Nothing is worse than getting to a job site and not having the right tool. However, because there are no standards or limitations on what manufacturers can use in their product line, always having the right tool on hand is impossible. Always remember that no toolkit is complete without an antistatic wrist strap.

Basic Electronics Overview

A technician needs to know a few basic electronic terms and concepts when testing components. The best place to start is with electricity. There are two types of electricity: AC and DC. The electricity provided by a wall outlet is **AC** (alternating current) and the type of electricity used by computer components is **DC** (direct current). Devices such as radios, TVs, and toasters use AC power. Low voltage DC power is used for the computer's internal components or anything powered by batteries. The computer's power supply converts AC electricity from the wall outlet to DC for the internal components. Electricity is nothing more than electrons flowing through a conductor, just as water runs through a pipe. With AC, the electrons flow alternately in both directions. With DC, the electrons flow in one direction only.

Electronic Terms

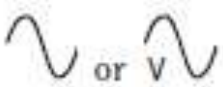
Voltage, current, power, and resistance are common electronic terms used in the computer industry. **Voltage**, which is a measure of the pressure pushing electrons through a circuit is measured in **volts**. A power supply's output is measured in volts. Power supplies typically put out +3.3 volts, +5 volts, –5 volts, +12 volts, and –12 volts. The term ***volts*** is also used to describe voltage from a wall outlet. The wall outlet voltage is normally 120VAC (120 volts AC). Exercises at the end of the chapter explain how to take voltage readings.

Figure 4.6 shows a photograph of a DC voltage reading being taken on the power connectors coming from the computer's power supply. The meter leads are inserted correctly and the voltage level is of the correct polarity. The reading on the meter could be the opposite of what it should be if the meter's leads are reversed. Since electrons flow from one area where there are many of them (negative polarity) to an area where there are few electrons (positive polarity), polarity shows which

way an electric current will flow. **Polarity** is the condition of being positive or negative with respect to some reference point. Polarity is not important when measuring AC.

Monitors and power supplies can have dangerous voltage levels. Monitors can have up to 35,000 volts going to the back of the CRT (cathode ray tube). 120 volts AC is present inside the power supply. Power supplies and monitors have capacitors inside them. A **capacitor** is a component that holds a charge even after the computer is turned off. Capacitors inside monitors can hold a charge for several hours after the monitor has been powered off. Capacitance is measured in farads. Note that a laptop display uses low DC voltage, not AC like that present in a desktop computer.

Another important consideration when taking voltage readings is to set the meter for the correct type of current. The AC voltage setting is for alternating current and the DC voltage setting is for direct current. Meters may have different symbols for AC and DC voltage, but the common symbols found on a meter for AC voltage are as follows:



The common meter symbols for DC voltage are as follows:

Always refer to the meter's documentation if you are unsure of the symbols. Know whether you are measuring AC or DC voltage and set the meter to the appropriate setting. Also note that some meters have voltage ranges (such as 0–10V, 0–100V, etc.) that must be set *before* taking a measurement. Some meters automatically sense what type of voltage is being measured and do not have these settings.

Current is measured in **amps** (amperes), which is the number of electrons going through a circuit every second. In the water pipe analogy, voltage is the amount of pressure applied to force the water through the pipe, and current is the amount of water flowing. Every device needs a certain amount of current to operate. The power supply is rated for the amount of total current (in amps) it can supply at each voltage level. For example, a power supply could be rated at 20 amps for the 5-volt level and 8 amps for the 12-volt level.

Current is what kills people when an electrical shock is received
Voltage determines how much current flows through the body. A high current and low voltage situation is the most dangerous.

Power is measured in **watts**, which is how much electrical work is being done. It is determined by multiplying volts by amps. Power supplies are described as providing a maximum number of watts. This is the sum of all outputs: For example, 5 volts × 20 amps (100 watts) plus 12V 8 amps (96 watts) equals 196 watts. An exercise at the end of the chapter explains how current and power relate to a technician's job.

All power supplies are not created equal
A technician needs to replace a power supply with one that provides an equal or greater amount of power. Search the Internet for power supply reviews. A general rule of thumb is that if two power supplies are equal in wattage, the heavier one is better because it uses a bigger transformer, bigger heat sinks, and more quality components.

Resistance is measured in **ohms**, which is the amount of opposition to current in an electronic circuit. The resistance range on a meter can be used to check continuity or check whether a fuse is good. A conductor in a cable or a good fuse will have very low resistance to electricity (close to zero ohms). A broken wire or a bad fuse will have very high resistance (millions of ohms, sometimes shown as infinite ohms). A **continuity** check is used to determine if a wire has a break in it. For example, a cable is normally made up of several wires that go from one connector to another. If you were to measure the continuity from one end of a wire to the other, it should show no resistance. If the wire has a break in it, the meter shows infinite resistance. Figure 4.7 shows an example of a good wire reading and a broken wire reading.

Digital meters have different ways of displaying infinity. Always refer to the meter manual for this reading.

When checking continuity, the meter is placed on the ohms setting, as shown in Figure 4.7. The ohms setting is usually illustrated by an omega symbol (Ω).

Polarity is not important when performing a continuity check. Either meter lead (red or black) can be placed at either end of the wire. However, you do need a pin-out diagram (wiring list) for the cable before you can check continuity because pin 1 at one end could connect to a different pin number at the other end. An exercise at the end of the chapter steps through this process.

The same concept of continuity applies to fuses. A fuse has a tiny wire inside it that extends from end to end. The fuse is designed so that the wire melts (breaks) if too much current flows through it. The fuse keeps excessive current from damaging electronic circuits or starting a fire.

A fuse is rated for a particular amount of current. For example, a 5-amp fuse protects a circuit if the amount of current exceeds 5 amps.

Use the right fuse or lose
Never replace a fuse with one that has a higher amperage rating. You could destroy electronic circuits or cause a fire by allowing too much current to be passed by the fuse, defeating the fuse's purpose.

Take the fuse out of the circuit before testing it. A good fuse has a meter reading of 0 ohms (or close to that amount). A blown fuse shows a meter reading of infinite ohms. Refer to the section on resistance and Figure 4.7. An exercise at the end of this chapter demonstrates how to check a fuse.

Basic Electronic Terms

Term	Value	Usage
Voltage	Volts	Checking AC voltage on a wall outlet (typically 120VAC). Checking the DC output voltage from a power supply (typically +/– 12 and +/–5VDC).
Current	Amps (amperes)	Each device needs a certain amount of current to operate. The power supply is rated for total current in amps for each voltage level (such as 20 amps for 5-volt power and 8 amps for 12-volt power).
Resistance	Ohms	Resistance is the amount of opposition there is to electric current. Resistance is used to check continuity on cables and fuses. A cable that shows little or no resistance has no breaks in it. A good fuse shows no resistance. If a cable has a break in it or if a fuse is bad, the resistance is infinite.
Wattage	Watts	Watts is a measure of power and is derived by multiplying amps by volts. Power supply output is measured in watts. Also, UPS's are rated in Volt-Amps. The size of UPS purchased depends on how many devices plug in to it.

Dissecting Your Computer

Before you can troubleshoot your computer, you need to understand what a computer is and how it's put together. A computer (or PC, for personal computer) is not a single unit, but is instead a collection of hardware subsystems including

- Video
- Storage
- Input devices
- Printers and other output devices
- Audio
- Networking
- Processor
- Memory
- Power
- Motherboard

The Outside Story of Typical Computers

Although the "inside" story of computers is even more complicated than the outside, don't neglect taking a good look at the outside of your system when it's time to troubleshoot a computer problem. You also need to check out the outside of the computer when it's time to plug in a peripheral to see if there's a suitable connector for it.

The outside of the computer is where you'll find

- Cable connections for external peripherals such as cable modems, printers, monitors, and scanners
- Drive bays for removable-media and optical drives
- The power supply fan and voltage switch
- The power cord between the computer and the wall outlet (and between external peripherals such as monitors and printers and the wall outlet)
- The power switch, reset button, and signal lights

All in all, the outside of the computer is a good place to start when your computer has stopped working, even if you're not sure if that's where the problem lies.

Points of Failure on the Front of a Computer

The front of the computer might provide valuable clues if you're having problems with a system. In case of problems, check the following common points of failure for help:

■ Can't read CD or DVD media—The drive door on the CD-ROM or other optical drive might not be completely closed or the media might be inserted upside down; press the eject button to open the drive, remove any obstacles, reseat the media, and close the drive.

■ Can't shut down the computer with the case power switch—The case power switch is connected to the motherboard on ATX and Micro-ATX systems, not directly to the power supply as with older designs. The wire might be loose or connected to the wrong pins on the motherboard.

Keep in mind that most systems require you to hold in the power button for about four seconds before the system will shut down. If the computer crashes, you might need to shut down the computer by unplugging it or by turning off the surge suppressor used by the computer. Some ATX power supplies have their own on-off switches, but this is not commonplace.

■ Can't see the drive access or power lights—As with the case power switch, these lights are also connected to the motherboard. These wires might also be loose or connected to the wrong pins on the motherboard.

■ Can't use USB, IEEE-1394, or digital camera (serial) ports on the front of the system—Some systems have these ports on the front of the computer as well as the rear. Front-mounted ports are connected with extension cables to the motherboard. If the cables inside the case are loose, the ports won't work. If the ports are disabled in the system BIOS, the ports won't work.

The Rear View of a Typical Desktop Computer

If the video has gone missing in action, you can't connect to the Internet, or your printer refuses to print, it's time to check out the rear of the computer.

Power supplies actually convert high-voltage AC power into the low-voltage DC power used inside the computer. Because conversions of this type create heat, the power supply has a fan to cool itself and also help overall system cooling. Although a few power supplies can switch between 115-volt and 230-volt (V) services automatically, most use a sliding switch.

Points of Failure on the Rear of Your Computer

The most likely point of failure on the rear of your computer is peripheral cabling. Fortunately, more and more devices use the lightweight USB cable instead of the bulky, heavy serial and parallel cables.

Note that serial, parallel, and VGA cables all use thumbscrews; if you don't fasten the thumbscrews to the connector on the computer, the cables won't connect tightly, which can cause intermittent or complete peripheral failure. Most SCSI cables use locking clips to hold them in place. If the clips aren't engaged, this can cause intermittent or complete SCSI peripheral failure.

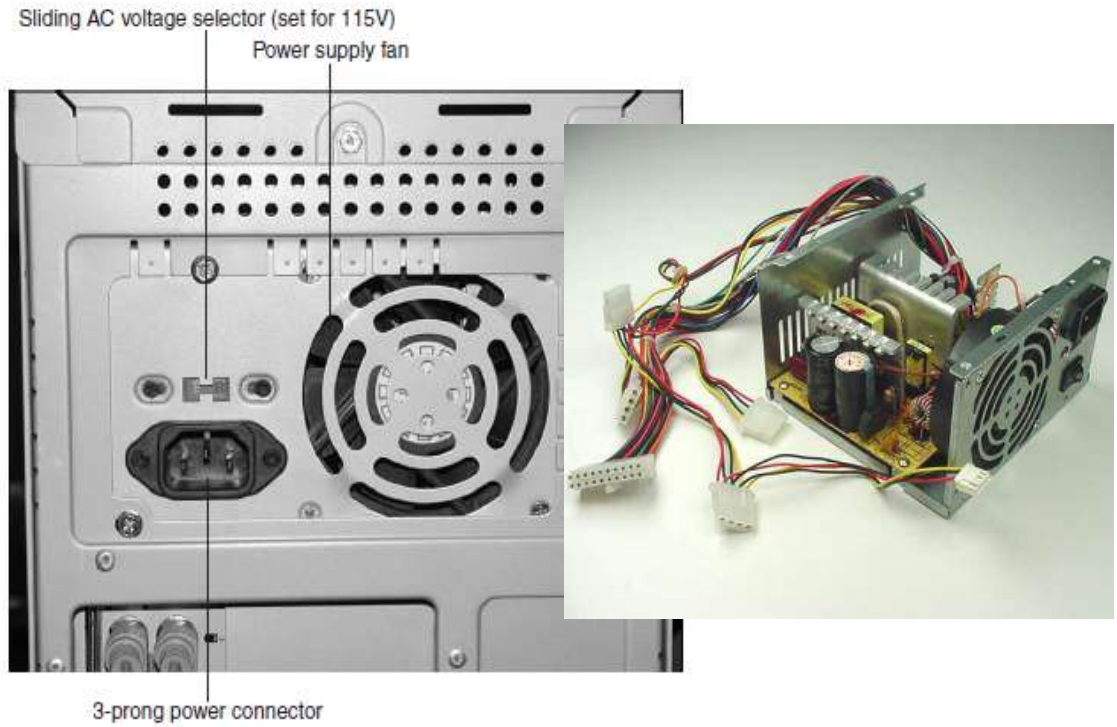
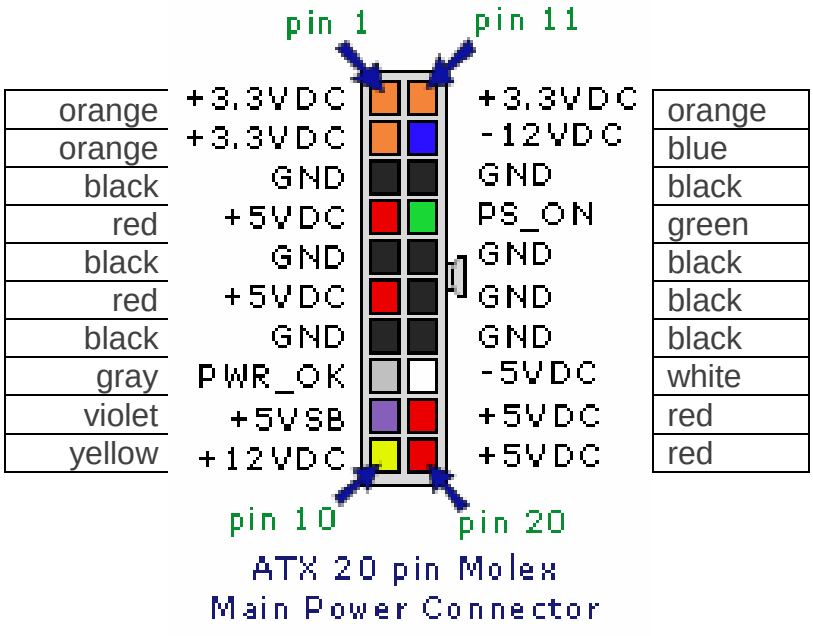
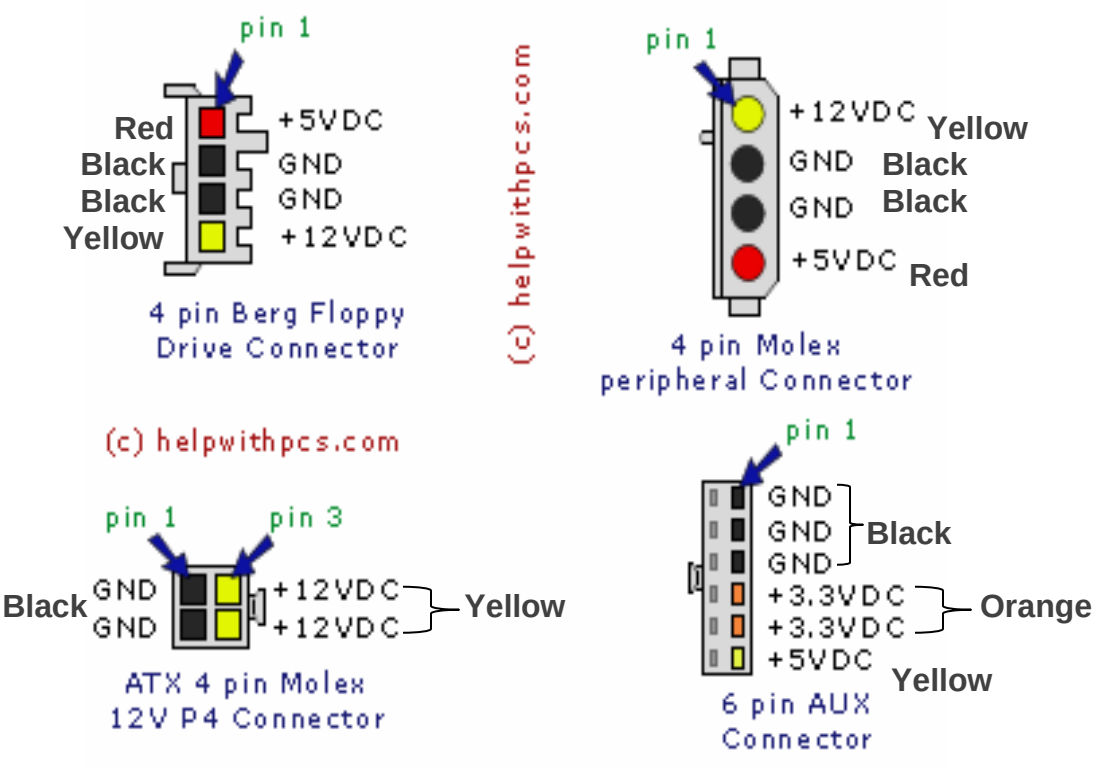


FIGURE 2.5
A typical power supply mounted in a computer.

Diagrams with pins facing forward





Causes and Failures of power supply

1. Overheating
2. Overloading
3. Fan failure
4. Inadequate air flow outside the system
5. Inadequate air flow inside the system
6. Dirt & dust

Purposes of a Power Supply

The power from a wall outlet is high voltage AC. The type of power computers need is low voltage DC. All computer parts (the electronic chips on the motherboard and adapters, the electronics on the drives, and the motors in the floppy drive, hard drive, and CD/DVD drive) need DC power to operate. Power supplies in general come in two types—linear and switching. Computers use switching power supplies. The main functions of the power supply include the following:

- Convert AC to DC
- Provide DC voltage to the motherboard, adapters, and peripheral devices
- Provide cooling and facilitate air flow through the case

- One purpose of the power supply is to convert AC to DC so the computer has proper power to run its components.
- Another purpose of the power supply is to distribute proper DC voltage to each component. Several cables with connectors come out of the power supply. With ATX motherboards, there is only a 20- or 24-pin connector used to connect power to the motherboard. The power connector inserts only one way into the motherboard connector.
- Another purpose for the power supply is to provide cooling for the computer. The power supply's fan circulates air throughout the computer. Most computer cases have air vents on one side, both sides, or in the rear of the computer. The ATX-style power supply blows air

inside the case instead of out the back. This is known as reverse flow cooling. The air blows over the processor and memory to keep them cool.

Symptoms of Power Supply Problems:

The following list offers symptoms of a power supply problem:
- The computer power light is off
- The power supply fan does not turn when the computer is powered on
- The computer sounds a continuous beep (this could also be a bad motherboard or a stuck key on the Keyboard)
- When the computer powers on, it does not beep at all (this could also be a bad motherboard)
- When the computer powers on, it sounds repeating short beeps (this could also be a bad motherboard)
- During POST, a 02X or parity POST error code appears (where X is any number); one of the POST checks is a power good signal from the power supply; a 021, 022, . . . error message indicates that the power supply did not pass the POST test
- The computer reboots without warning
- The power supply fan is noisy
- The power supply is too hot to touch
- The monitor has power light, but nothing appears on the monitor and no PC power light illuminates

Adverse Power Conditions

There are two adverse AC power conditions that can damage or adversely affect a computer: overvoltage and undervoltage. **Overvoltage** occurs when the output voltage from the wall outlet (theBAC voltage) is over the rated amount. Normally, the output of a wall outlet is 110 to 130 volts AC.

When the voltage rises above 130 volts, an overvoltage condition exists. The power supply takes the AC voltage and converts it to DC. An overvoltage condition is harmful to the components because too much DC voltage destroys electronic circuits. An overvoltage condition can be a surge or a spike.

When the voltage falls below 110 volts AC, an **undervoltage** condition exists. If the voltage is too low, a computer power supply cannot provide enough power to all the components. Under these conditions, the power supply draws too much current, causing it to overheat, weakening or damaging the components. An undervoltage condition is known as a brownout or sag. Table 4.7 explains these power terms.

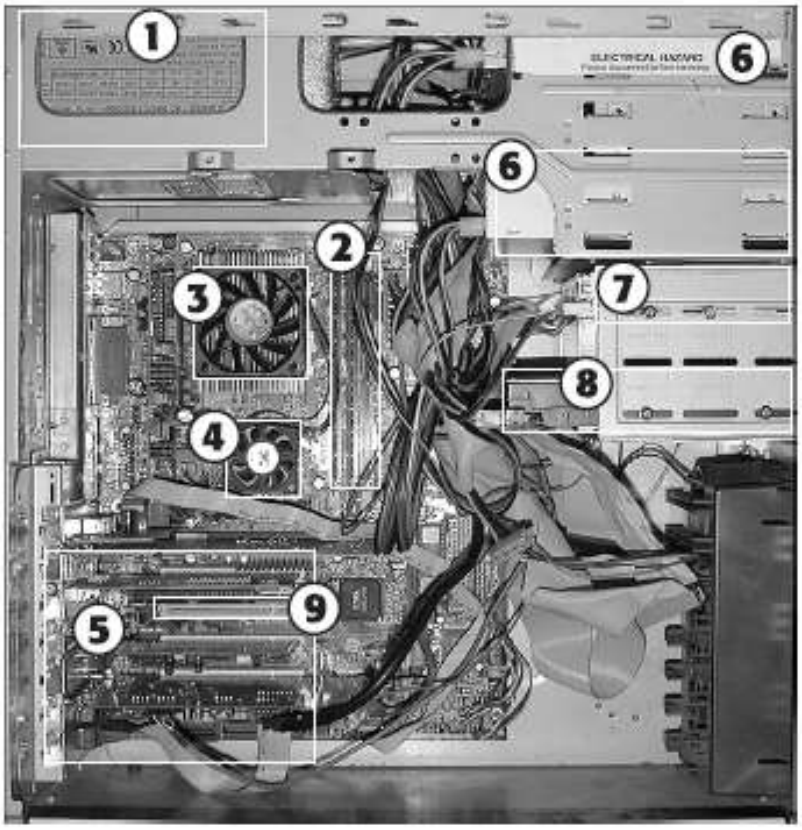
Table 4.7 Adverse power conditions

Major type	Subtype	Explanation
Overvoltage	**spike**	A spike lasts one to two nanoseconds. A nanosecond is a billionth of a second. A spike is harder to guard against than a surge because it has such short duration and high intensity.
	surge	A surge lasts longer (three or more nanoseconds) than a spike. Also called transient voltage. Causes of surges include lightning, poorly regulated electricity, faulty wiring, and devices that turn on periodically, such as elevators, air conditioners, and refrigerators.
Undervoltage	**brownout**	A brownout is when power circuits become overloaded. Occasionally, an electric company intentionally causes a brownout to reduce the power drawn by customers during peak periods.
	sag	A sag occurs when the voltage from the wall outlet drops momentarily.
	blackout	A total loss of power.

Inside a Typical PC

As you have already learned, some problems that manifest themselves on the outside of the computer come from problems inside the computer. If you ever add memory, add an internal drive, upgrade your processor or motherboard, or add a card to your computer, you will need to work with the interior of the computer to complete these tasks.

FIGURE 2.10
The interior of a typical PC using an ATX motherboard.



1. Power supply
2. Memory modules
3. Processor with fan/heatsink
4. North Bridge chip with fan/heatsink
5. Add-on cards
6. Optical drives
7. Floppy drive
8. Hard drive
9. Empty PCI slot

Points of Failure Inside the Computer

Some of the problems you could encounter because of devices inside your computer Include

- ***Overheating***—Failure of the fans in the power supply or those attached to thebprocessor, North Bridge chip, or video card can cause overheating and can lead to component damage.

- ***Loose add-on cards*** —A loose add-on card might not be detected by plug-and-play or the Windows Add New Hardware Wizard, or might have intermittent failures after installation.
- ***Inability to start the computer***—A loose processor or memory module can prevent the computer from starting (see Figures 2.13 and 2.14).

- ***Drive failures***—If drives are not properly connected to power or data cables, or are not properly configured with jumper blocks, they will not work properly.

- **Multimedia failures**—If the analog or digital audio cable running from the CD-ROM or other optical drive to the sound card is disconnected, you might not be able to hear CD music through the speakers. Some high-end sound cards also have connections to an external breakout box for additional speaker or I/O options. Be careful when you work inside a computer to avoid disconnecting these cables.

- ***Front panel failures***—The tiny cables that connect the case power switch, reset switch, and status lights are easy to disconnect accidentally if you are working near the edges of the motherboard.

- ***Battery failure***—The battery maintains the system settings that are configured by the system BIOS. The settings are stored in a part of the computer called the CMOS, more formally known as the non-volatile RAM/real-time clock (NVRAM/RTC). If the battery dies (the average life is about two to three years), these settings will be lost. After you replace the battery, you must re-enter the CMOS settings and save the changes to the CMOS before you can use the system.

- ***BIOS chip failure***—The system BIOS chip can be destroyed by electro-static discharge (ESD) or lightning strikes. However, BIOS chips can also become outdated. Although some systems use a rectangular socketed BIOS chip, others use a square BIOS chip that might be socketed or surface-mounted. In both cases, software BIOS upgrades are usually available to provide additional BIOS features, such as support for newer processors and hardware.

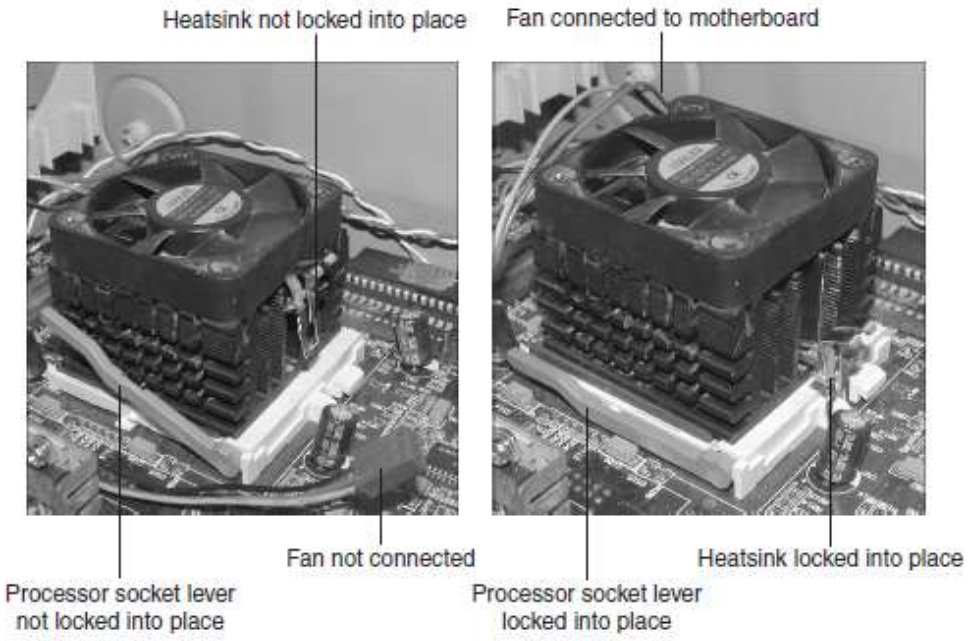
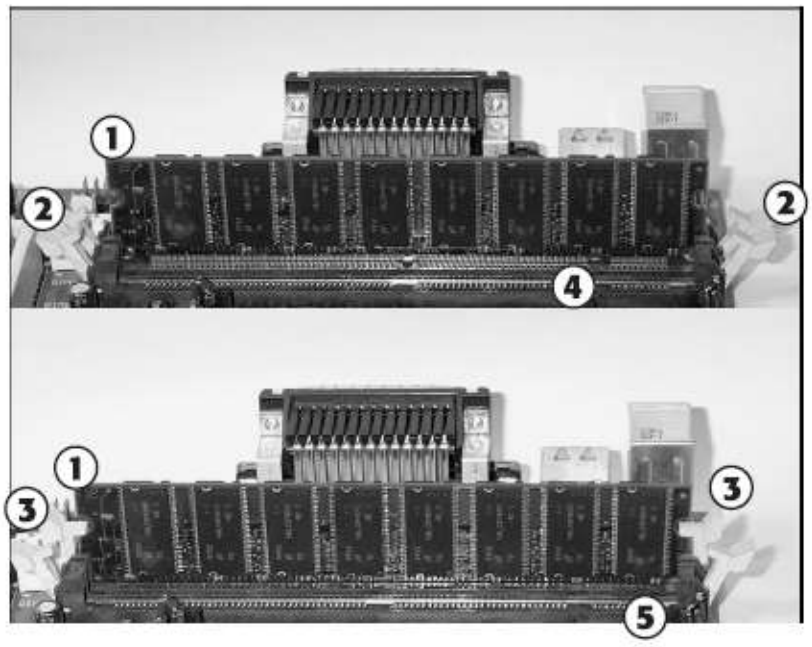


FIGURE 2.13
A socket-based processor before (left) and after (right) serious problems were corrected.



1. DIMM memory module
2. Module locks in open position
3. Module locks in closed position
4. Memory module edge connector before module fully inserted
5. Memory module edge connector after module fully inserted

FIGURE 2.14
A memory module before (top) and after (bottom) being locked into its socket.

The System BIOS

The system BIOS chip shown in Figure 2.23 is responsible for configuring many parts of your computer, including:

- Floppy, optical, and hard drive configuration
- Memory size and speed
- Drive boot sequence
- Built-in port configuration
- System security
- Power management
- Plug-and-play hardware configuration
- Processor compatibility and speed setting

Essentially, the BIOS acts as a restaurant menu of possible choices, and the CMOS RAM (which might be a separate chip or built into the South Bridge on some chipsets) stores the selections made from the menu of choices. When you received your computer from the factory, default selections were already stored in the BIOS, but as you add devices or customize your computer to perform certain operations, you might need to make additional choices. The battery shown in Figure 2.23 maintains the contents of CMOS memory; a typical battery lasts for two years or longer.

How the BIOS Displays Your PC's Components

Although some computers display only a system manufacturer's logo at startup, forcing you to read the system manual to determine which key to press to start the BIOS setup program, others, particularly "white box" computers that use a collection of components from various vendors, or systems that use a replacement motherboard, can provide you with a lot of useful information at startup. Figure 2.24 shows a typical example of the BIOS chip's POST (power-on self-test) program detecting onboard storage (the memory size is displayed briefly on many systems first). The display also shows which key to press to start the setup program.

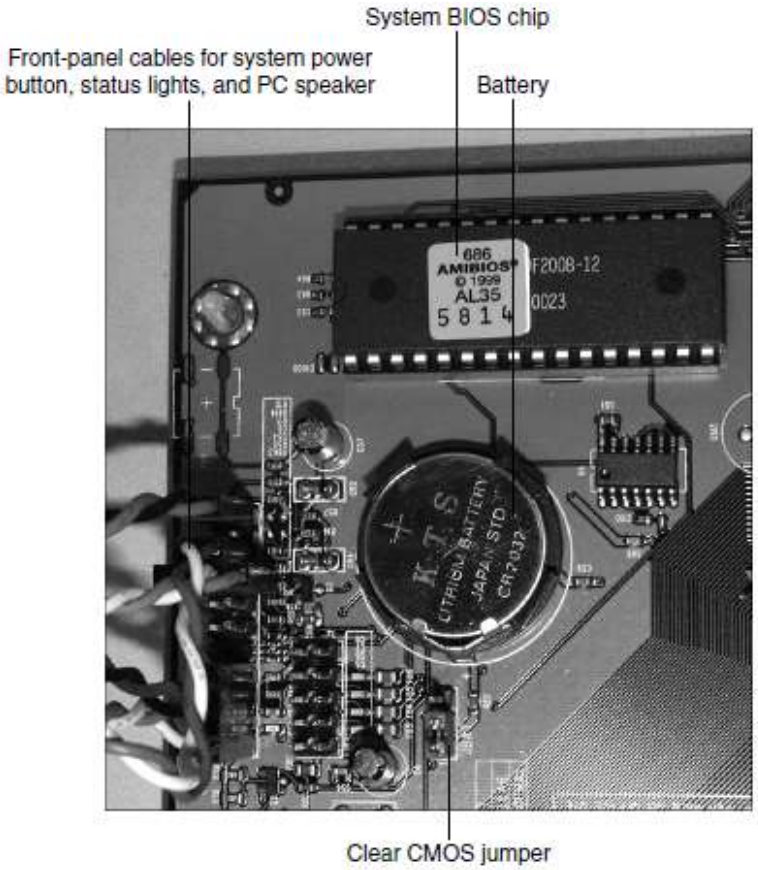
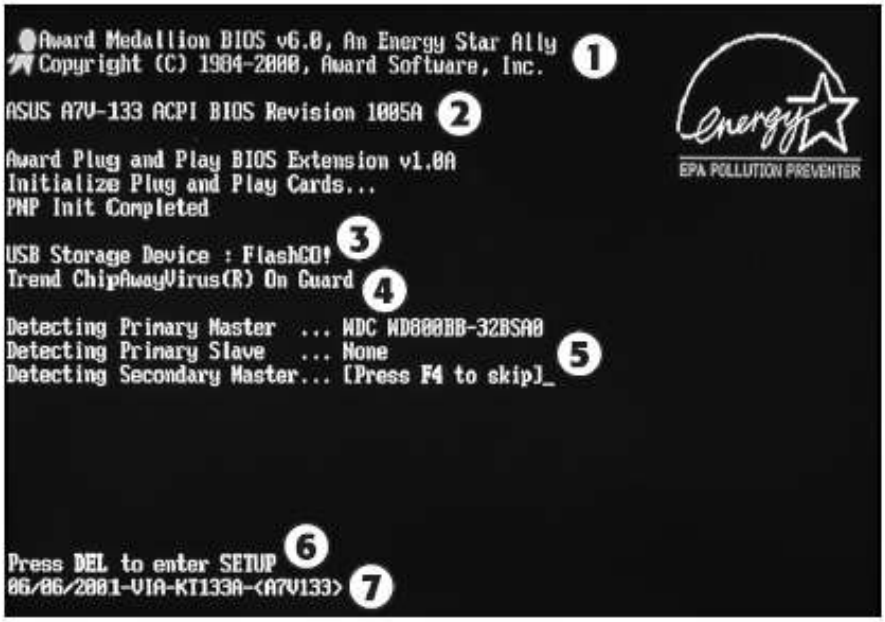


FIGURE 2.23
The front-panel cables, BIOS chip, and battery on a typical motherboard.

FIGURE 2.24
A typical startup screen displaying detected drives, chipset, and BIOS information.

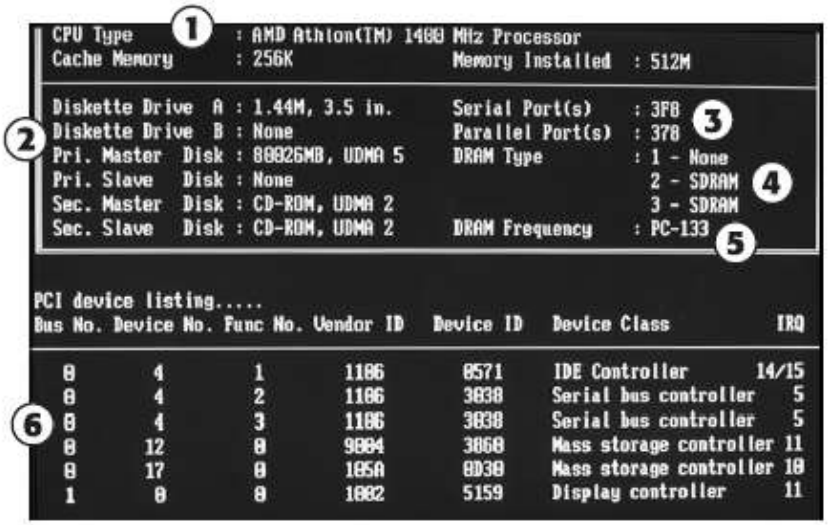


1. BIOS vendor and release information
2. Motherboard vendor and model number
3. USB storage device(s)
4. Anti-virus feature enabled
5. Detected ATA/IDE drives
6. How to start the BIOS setup program
7. BIOS date and chipset information

Many systems that display information similar to that shown in Figure 2.24 also display a condensed listing of onboard hardware before starting Windows (see Figure 2.25). Because this information should not change on a day-to-day basis unless you change your system configuration (BIOS changes or hardware upgrades), displaying this information at startup is a valuable aid to troubleshooting a sick system.

One of the reasons it's so important to display this information when you start your computer (if your system permits it) is because you will know immediately if there are any changes in your hardware configuration. If the configuration information displayed some day at startup differs from the normal information you see, it might mean that:

- Someone has changed the system's normal BIOS configuration.
- The computer has reverted to default settings for troubleshooting or other reasons.
- The computer's battery is failing, causing stored setup information to be lost or corrupted.
- The hardware inside your computer has failed, or has been removed/replaced.



1. Processor type, speed, and memory size information
2. Drive information
3. I/O port addresses for serial and parallel ports
4. Memory slot usage
5. Memory speed
6. Onboard PCI devices

TERMS:

IRQs, or **interrupt requests**, are a series of 8 or 16 lines that run between the CPU and both built-in and expansion card devices.

ISA – Industry Standard Architecture. is a retronym term for the 16-bit internal bus of IBM PC/AT and similar computers based on the Intel 80286 and its immediate successors during the 1980s.

PCI – Peripheral Component Interconnect. is a local computer bus for attaching hardware devices in a computer.

AGP – Accelerated Graphics Port. (often shortened to AGP) is a high-speed point-to-point channel for attaching a video card to a computer's motherboard, primarily to assist in the acceleration of 3D computer graphics

Video Graphics Array (VGA) refers specifically to the display hardware first introduced with the IBM PS/2 line of computers in 1987

XT stands for eXtended Technology.PC XT, or simply XT, was a version of the IBM PC with a built-in hard drive

AT stood for "Advanced Technology", and was chosen because the AT offered various technologies that were then new in personal computers

ATX (Advanced Technology eXtended) is a motherboard form factor specification developed by Intel in 1995 to improve on previous de facto standards like the AT form factor.

Serial Advanced Technology Attachment (SATA) is a computer bus interface that connects host bus adapters to mass storage devices such as hard disk drives and optical drives.

Advanced Host Controller Interface (AHCI) is an open host controller interface published and used by Intel, which has become a de facto standard. It allows the use of advanced features of SATA such as hotplug and native command queuing (NCQ).

APM (Advanced Power Management) was originally developed by Microsoft, Toshiba, and Intel. APM allows the operating system to control devices such as the hard drive and monitor when the computer is not in use.

ACPI (Advanced Configuration and Power Interface), which combines the features of APM and plug and play to give the motherboard and operating system control over various devices' power and modes of operation.

http://en.wikipedia.org/
ABG to A+ Certification
The Complete A+ Guide to PC Repair 5th ed. - C. Schmidt (Pearson, 2012) BBS