Lesson 2
Parts are adapted from *Windows 98* by Mark Twain Media, Inc.

*A Computer System has Hardware and Software*

All the parts--monitor, printer, hard drive, etc.-- cables, cabinets, and programs that make a computer work are called the **COMPUTER SYSTEM**. Everything necessary to do the 4 jobs of the computer together composes the computer system. The **COMPUTER** is simply the processor, the chip. But the chip needs a way to take in information, store information and give out information for the chip to be useful (who wants to process information if you can’t get the answer out of the computer?!) The computer system is composed of all the hardware and software needed to do the job of the computer. Computer **HARDWARE** is the term used to describe the physical parts of the computer. These are the parts that you can touch, that have form. Computer **SOFTWARE** is the set of commands that tell the computer what to do. You can’t see commands. The computer system needs both hardware and software to do the job of the computer. In this Lesson we will study the hardware. We will organize our study by the jobs of the computer.

*The Processor*

The hardware that does the processing is a **MICROPROCESSOR**. The microprocessor is also called a chip. The microprocessor has been doing the processing since around 1970 when the 4th generation of computers began. One of the largest producers of chips is a company called Intel. Chips continue to improve and processing time continues to be faster. The chip used today is greatly improved over the chip of 1970!

A computer can have more than one microprocessor. A computer with two processors is referred to as a dual-processor. With two processors the computer can do more work faster!

One of the microprocessors is called the **CENTRAL PROCESSING UNIT**. The CPU directs all the operations of the computer. The CPU is divided into two
parts, the CONTROL UNIT and ARITHMETIC LOGIC UNIT. The control unit makes sure the parts of the computer are working correctly. The arithmetic logic unit is where the work of the computer is done. In the ALU, application programs are run. The control unit makes sure the computer works and the ALU executes the programs that users want run.

The CPU sits on the motherboard. The motherboard is a circuit board that connects all equipment to the CPU. From its throne on the motherboard, the CPU accesses all equipment and directs the action of the hardware and software.

**Computer Memory**

The computer needs to keep information for long and short periods of time. This is accomplished in the computer’s memory. Computer memory is divided into two types of memory: Short term and Long term.

Primary Memory

Short term memory, also called PRIMARY memory, is where the commands that the computer is using right now are stored. When you open a program, the commands load into primary memory. This is like your short term memory. You don’t keep everything you know in your head! Can you imagine if you were always thinking every person’s name that you know, every activity you in which you are involved and everything you’ve learned in school? You’d be on brain overload! The computer would be on overload if it kept every program it had ever run in its memory! So the computer keeps the commands for all its programs in one place and only takes out the commands for the programs the user wants to use. That way the computer can focus on just those programs. These commands are put into primary memory for use by the computer.

The hardware used for primary memory is called RANDOM ACCESS MEMORY OR RAM. You can go to a computer shop and buy sticks of RAM. It then plugs into a slot on the motherboard ready to load commands for use by the CPU. Being directly connected to the motherboard makes the commands in RAM available very quickly!
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RAM can be described as **TEMPORARY**. Anything in RAM will be removed when the user no longer needs the commands. When the power is turned off, the computer reads that as the user no longer needing the information and erases RAM. RAM is generally smaller than long term storage. It takes less room to just load the commands being used than it takes to store every command you know. So the RAM only holds information temporarily, while the commands are in use, and it does not hold very much.

**Long Term Memory**

The computer needs room to keep all the programs you want to load onto the computer to keep until you want to use the program. It keeps these commands in long term memory also called **SECONDARY MEMORY**. These secondary memory devices are attached to the motherboard through cables (they do not directly plug into the motherboard). When you open a loaded program, the processor gets the commands from secondary storage and loads the commands into RAM. Secondary storage is like your long term memory. You don’t think about computers every day all the time, do you? So computer information isn’t kept in your RAM, but rather in your long term memory (like your folder!). When you need the information in class or for a test, you pull the information from long term memory and puts it in your short term memory—what you are thinking right now!

Secondary storage is often called **PERMANENT** storage. Data and programs saved in secondary storage will remain until it is erased or the storage device breaks. When you push save on the computer you are putting something in secondary storage. It will be in storage when you recall it.

Secondary memory has to be very large to hold the commands for the programs and data. Several different devices provide secondary storage. Different types of storage are used for permanent storage. The different storage devices can be divided into 3 types of storage:

1. **MAGNETIC**
2. **OPTICAL**
3. **FLASH**
Magnetic storage

Magnetic storage works by magnetizing and not magnetizing metal particles on a disc or tape. Magnetized parts are said to be “on”. Non-magnetized parts are said to be “off”. The series of ons and offs is a code to the computer. Think about lights in a window. You tell your best friend that if you open the blinds three times, it is safe to come in through the window! But if you only open the blinds two times, it isn’t safe! You have shared a code of on (open blinds) and offs (closed blinds). Like your friend, the computer understands the code and follows the instructions in the code.

Since magnetic storage uses magnetized particles then you should not put magnets near magnetic storage. For this reason you may find refrigerator magnets, but not computer magnets!

Examples of magnetic storage devices include HARD DISKS and FLOPPY DISKS. Hard disks can be “in the box” -- internal storage or external storage. Every computer has to have a hard disk. The system software is stored on the hard disk. The hard disk is often the largest storage device attached to your computer.

In order to use hard disks and floppy disks, the disk needs to be prepared to accept data from a specific hard drive. This is called FORMATTING the disk. Formatting sets up the grid in which the memory will be saved. Sometimes when a hard disk is corrupted, the easy way to fix it is to re-format the disk. If you do this, you will lose all of your data and programs. So be sure you want to re-format the disk!

The floppy disk is REMOVABLE STORAGE, which means the storage device can be removed from the computer. However, the floppy disk is a small storage device. The floppy disk is slowly being phased out of common storage devices. If you buy a computer system today, it will probably not include a floppy DISK DRIVE (the equipment necessary to read the disk).

Floppy disks were manufactured with the ability to “lock” the disk so you can’t change the data and programs. This is called “WRITE PROTECT”. Even
though we don’t use floppies much anymore, the concept of write protect is used in other places. Within many programs, such as MS Word you can “write protect” a file so it can’t be changed, only read. There are advantages to allowing someone to see a file and not change it (like your grade in a grading program). To lock a file or disk so the user can’t change the data or program, you can use write a protect command.
Optical Storage

Optical storage devices use a laser and a disk. The laser cuts pits in the disk. The combination of pitted areas and areas without pits (called lands) form a code that the laser reads into the computer. Again you have two options, **PIT AND LAND.** The computer reads the code and follows the instruction in the code.

Optical storage disks are removable storage. The computer needs a “reader” to read the optical disks. You will probably have an optical storage reader called a driver “in the box”. You can also buy external drives.

Examples of optical storage are CD and DVD. There are three types of CDs or compact disks: CD-ROM; CD-R; CD-RW. Here is the difference between the types of CD’s.

1. **CD-ROM:** (compact disk read only memory) This is a disk that can be read by the computer but the data cannot be changed. You cannot write or erase the disk. These types of disks are used for programs or music that you buy at the store.

2. **CD-R:** (compact disk recordable) This type of disk allows a user to read the data on the disk and write to a disk. However, once you write to the disk, you can’t change the disk. You can read and write but not erase. These disks are good for daily work.

3. **CD-RW:** (compact disk re-writable) This type of disk allows you to do it all! You can read, write and erase the data on this disk. These disks are also good for daily work. However, these disks are more expensive than CD-R, so are less popular.

DVD’s are similar to CD’s and the same ROM, R, and RW. A DVD has more storage than a CD and will hold a movie, not just the music! DVD can mean several words. Digital Video Disk was the original meaning because the DVD was originally only used for videos. However, the DVD is used for many different reasons today so Digital Versatile Disk is more apt.

**Flash Memory**
The newest type of memory is flash memory. It is removable storage. Data is stored on a circuit board. Open (off) and closed (on) circuits hold the code that the computer reads and then acts on.

Examples of this type of storage are a memory card/stick and keychain drives, It varies greatly in size from 1 gb up to 160 gb. Flash storage uses the USB port on the computer. A port is an access point to the motherboard. The USB port is a rectangular port. A USB connection is faster than older forms of connection.

Measuring Memory

Several times in this handout, we’ve referred to the size of the storage device. How do we measure the capacity of a storage device? We count the bytes! What is a byte? Remember those ons and offs; those pits and lands? Each on or off is called a bit. We put 8 bits together to define a letter, number or symbol. 8 bits is called a byte. The size of a storage device is stated in how many bytes the device can hold.

Bytes add up very fast. So we don’t say just bytes. We start with about 1,024 bytes and call that many bytes a kilobyte. The next size is 1,048,576 bytes or a megabyte. A gigabyte is 1,073,741,824 bytes. A terabyte is 1,099,511,627,760 bytes. Of course it’s hard to remember those big numbers so we use approximates:

1. Kilobyte is approximately 1000 bytes
2. Megabyte is approximately 1 million bytes
3. Gigabyte is approximately 1 billion bytes
4. Terabyte is approximately 1 trillion bytes.

Here is a list of storage devices and the sizes:

1. Hard disk: 80 gb to as much as 1 tb
   a. Common size: hard to say but a search of computer ads in August 2010, found 100 to 400 gb on average
2. CD’s: 600-700 mb
3. DVD’s: about +/- 4 gb
4. Floppy Disk: 144 mb (so small! A CD holds the same as about 400 Floppy disks)
5. Flash Stick drives: 1 to 8 gb
6. Memory disk: 128 mb up to 4+gb
7. Flash Memory in devices such as Ipods or phones
Input Devices

Input devices allow humans to take data in a form humans understand and give it to the computer in a form the computer can understand. There are several devices we use to input data into the computer.

Keyboard

The oldest input device is the keyboard. It is patterned after the typewriter, which has been around for over 150 years! As you know the keyboard has keys with the alphabet and numbers on it. But there are other special keys. The special keys allow the lettered and numbered keys to be used for other commands and entries. These special keys include:

1. Control (ctrl) key
2. Alt
3. Shift
4. F Keys

Use the Ctrl, Alt or shift key with the letter keys to use the keyboard for commands. For example: ctrl + V key tells the computer to paste. The F keys are across the top of the keyboard and range from F1 to F12. The F keys were used before the mouse became popular. You might still see the F commands on old programs. The F keys are still used for different commands depending on the program.

Two more important keys are Enter and ESC. Enter tells the computer to do something. In word processing, enter takes you to the next line. But in other cases, enter tells the computer to carry out a command. ESC does the opposite. If you want to cancel a command, press the ESC key to cancel a command (it doesn’t undo, just cancels).

Mouse

The mouse is another input device. The mouse has a part that moves. The movement is picked up by the computer and moves a pointer on the screen. When the pointer rolls over a GUI, you can click a button on the mouse to execute the command associated with the GUI. A GUI is a graphic
user interface:  A picture (graphic) that allows humans (the user) to communicate (interface) with the computer. A GUI is associated with a command that can be executed when you click on the GUI. The graphic associated with a GUI is called an ICON.

Scanner/Digital Camera/web cam

These picture based devices use pixels to input data. Pixels are dots of color that are put together to form a picture. Think light bright! The picture is divided into a grid of pixels. The pixels’ colors and locations are stored as commands by the computer. The computer can follow the commands for the pixels to make a picture.

Microphone

A microphone takes a sound wave and identifies points on the wave to tell the computer about sound. The more points of the sound wave that are identified to the computer, the clearer and more realistic the sound.

Output Devices

An output device allows the computer to communicate with humans. The computer processes in a series of electrical charges. We don’t read those very well, so the computer has to change the output so we can understand it.

Monitor

A monitor gives us visual output-you can see it! The output from a monitor is called softcopy. You can’t hold it. A monitor uses pixels to create the screen. How the pixels are created is the difference between monitors. The CRT (Cathode Ray Tube) uses a magnetic field to create the colors. The LCD (Liquid Crystal Display) uses chemicals to create the colors. The CRT is old technology based on early televisions. The LCD was first used in early laptops but is now the most common type of monitor.

Printer
Sometimes you want output that you can keep and take with you. Printers provide us with hard copies that we can touch. There are three types of printers: printers that strike the paper through a ribbon, printers that spew ink onto the paper in the form of letters and numbers, and printers that use toner and burn the toner into the paper.

Printers that strike paper are called dot matrix. A group of metal rods rearrange themselves to make different letters and numbers. The rod strikes the paper through an inked ribbon and leaves an impression on the paper. These printers are still used when you need carbon copies (to imagine a carbon copy, think DN!). These printers only print in one color at a time. They are slow, forming each letter as it goes one way across the paper. It is also noisy!

The ink jet printer uses cartridges of ink to make letters. The ink is spewed onto the paper in different shapes. Although originally only available in black, ink jets today use color ink as well. The ink jet is more versatile than the dot matrix. It can print in color and can print faster. The ink jet is not very noisy. Although the ink is usually expensive the printer itself is cheap. The ink jet is ideal for home use. At home we don’t demand as many copies to be printed so we won’t buy much ink. The lower cost of the printer is an important consideration.

The laser printer uses toner, a very fine powder. The laser printer uses the same technology as a copy machine. Many copy machines today double as printers. The toner is attracted to a drum (big metal thing) and then when a paper goes over the drum the toner is burned into the paper. Ever get a copy or printout right out of a laser printer? It is hot! The laser printer itself is expensive. The toner cartridges can be expensive too, but you can get thousands of copies out of one toner cartridge! Because schools and businesses make many copies, a laser printer is a good choice due to the cheap price of each printout.

Wrap Up
A computer needs hardware and software to do the four jobs of the computer; this is called a computer system. The hardware that does the processing is a microprocessor; the main microprocessor is called the CPU. The CPU sits on the motherboard. The computer keeps commands it is using now in Primary memory and commands it wants to use later in Secondary Memory. We measure the size of a storage device in bytes: kilobytes, megabytes, gigabytes and terabytes. The computer system includes input devices which allow humans to communicate with the computer. Several hardware devices perform the input function: keyboard, mouse, scanner, digital camera, web camera and microphone. Finally the computer gives out the processed data thought output devices. Output devices include printers and monitors.