CSC101

Components of a Computer System

Information is funny stuff. The information for the web page you are looking at is recorded on a hard disk inside a computer located in New Britain, Connecticut. The information was copied from that physical device to other physical devices perhaps hundreds of times before it got to your computer where your web browser is using it to display these words on your monitor. Clearly information is something different from the devices used to store and transmit it.

A computer system consists of both hardware and information stored on hardware. Information stored on computer hardware is often called *software*.

The **hardware** components of a computer system are the electronic and mechanical parts.

The **software** components of a computer system are the data and the computer programs.

Click Here to see the desktop system these notes were originally prepared on. (This was back when anything to do with computers had to be beige. Everything in this picture has since been replaced, except for the gargoyle.)

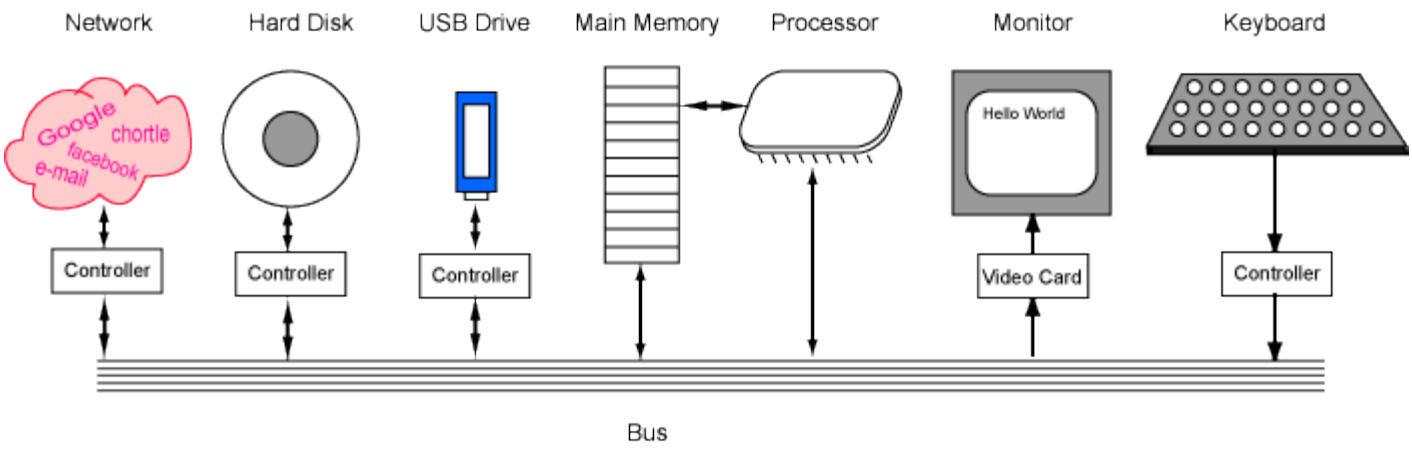
The major hardware components of a computer system are:

- Processor
- Main memory
- Secondary memory
- Input devices
- Output devices

For typical desktop computers, the processor, main memory, secondary memory, power supply, and supporting hardware are housed in a metal case. Many of the components are connected to the main circuit board of the computer, called the *motherboard*. The *power supply* supplies power for most of the components. Various input devices (such as the keyboard) and output devices (such as the monitor) are attached through connectors at the rear of the case.

So a lot easily the foregoing USER and DATA are components of the Computer System.

Hardware Components



Main Components of a Computer System

The terms *input* and *output* say if data flow into or out of the computer. The picture shows the major hardware components of a computer system. The arrows show the direction of data flow.

A **bus** is a group of wires on the main circuit board of the computer. It is a pathway for data flowing between components. Most devices are connected to the bus through a **controller** which coordinates the activities of the device with the bus.

The **processor** is an electronic device about a one inch square, covered in plastic. Inside the square is an even smaller square of silicon containing millions of tiny electrical parts. A modern processor may contain billions of transistors. It does the fundamental computing within the system, and directly or indirectly controls all the other components.

The processor is sometimes called the **Central Processing Unit** or **CPU**. A particular computer will have a particular type of processor, such as a Pentium processor or a SPARC processor.

Memory

The processor performs all the fundamental computation of the computer system. Other components contribute to the computation by doing such things as storing data or moving data into and out of the processor. But the processor is where the fundamental action takes place.

A processor chip has relatively little memory. It has only enough memory to hold a few instructions of a program and the data they process. Complete programs and data sets are held in memory external to the processor. This memory is of two fundamental types: main memory, and secondary memory.

Main memory is sometimes called **volatile** because it looses its information when power is removed. Secondary memory is usually nonvolatile because it retains its information when power is removed. (However, it needs power when information is stored into memory or retrieved from it.)

Main memory is sometimes called **main storage** and secondary memory is sometimes called **secondary storage** or **mass storage**.

- **Main memory:**
  - closely connected to the processor.
  - stored data are quickly and easily changed.
  - holds the programs and data that the processor is actively working with.
  - interacts with the processor millions of times per second.
  - needs constant electric power to keep its information.

- **Secondary memory:**
  - connected to main memory through the bus and a controller.
  - stored data are easily changed, but changes are slow compared to main memory.
  - used for long-term storage of programs and data.
  - before data and programs can be used, they must be copied from secondary memory into main memory.
  - does not need electric power to keep its information.

Main Memory

Main memory is where programs and data are kept when the processor is actively using them. When programs and data become active, they are copied from secondary memory into main memory where the processor can interact with them. A copy remains in secondary memory.

Main memory is intimately connected to the processor, so moving instructions and data into and out of the processor is very fast.

Main memory is sometimes called **RAM.** RAM stands for **Random Access Memory**. "Random" means that the memory cells can be accessed in any order. However, properly speaking, "RAM" means the type of silicon chip used to implement main memory.

Secondary Memory

Secondary memory is where programs and data are kept on a long-term basis. Common secondary storage devices are the hard disk and optical disks.

- The hard disk has enormous storage capacity compared to main memory.
- The hard disk is usually contained inside the case of a computer.
- The hard disk is used for long-term storage of programs and data.
- Data and programs on the hard disk are organized into files.

- A **file** is a collection of data on the disk that has a name.

A hard disk might have a storage capacity of 500 gigabytes (room for about 500 x 10^9 characters). This is about 100 times the capacity of main memory. A hard disk is slow compared to main memory. If the disk were the only type of memory the computer system would slow down to a crawl. The reason for having two types of storage is this difference in speed and capacity.

Large blocks of data are copied from disk into main memory. The operation is slow, but lots of data is copied. Then the processor can quickly read and write small sections of that data in main memory. When it is done, a large block of data is written to disk.

Often, while the processor is computing with one block of data in main memory, the next block of data from disk is read into another section of main memory and made ready for the processor. One of the jobs of an operating system is to manage main storage and disks this way.

Primary memory	**Secondary memory**
• Fast	• Slow
• Expensive	• Cheap
• Low capacity	• Large capacity
• Works directly with the processor	• Not connected directly to the processor

Input and Output Devices

Input and output devices allow the computer system to interact with the outside world by moving data *into* and *out of* the system. An *input device* is used to bring data into the system. Some input devices are:

- Keyboard
- Mouse
- Microphone
- Bar code reader
- Graphics tablet

An *output device* is used to send data out of the system. Some output devices are:

- Monitor
- Printer
- Speaker

A network interface acts as both input and output. Data flows from the network into the computer, and out of the computer into the network.

How to Convert from Decimal to Binary

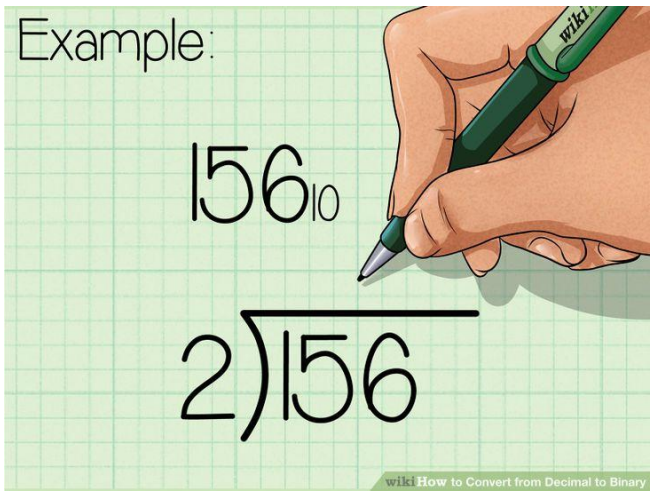
Three Methods: Short Division by Two with Remainder

The decimal (base ten) numeral system has ten possible values (0,1,2,3,4,5,6,7,8, or 9) for each place-value. In contrast, the binary (base two) numeral system has two possible values represented as 0 or 1 for each place-value.[1] Since the binary system is the internal language of electronic computers, serious computer programmers should understand how to convert from decimal to binary.

Decimal to Binary Converter

Method 1

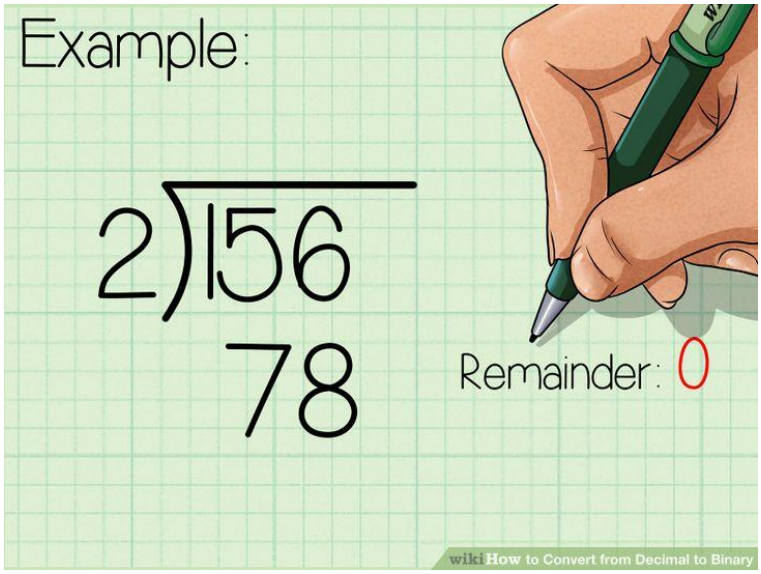
Short Division by Two with Remainder

1. 

   1

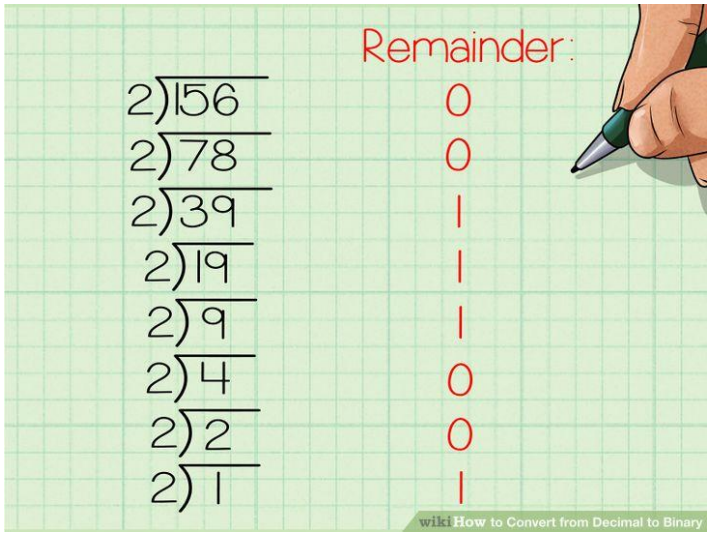
   Set up the problem. For this example, let's convert the decimal number 156_{10} to binary. Write the decimal number as the dividend inside an upside-down "long division" symbol. Write the base of the destination system (in our case, "2" for binary) as the divisor outside the curve of the division symbol.

   - This method is much easier to understand when visualized on paper, and is much easier for beginners, as it relies only on division by two.
   - To avoid confusion before and after conversion, write the number of the base system that you are working with as a subscript of each number. In this case, the decimal number will have a subscript of 10 and the binary equivalent will have a subscript of 2.

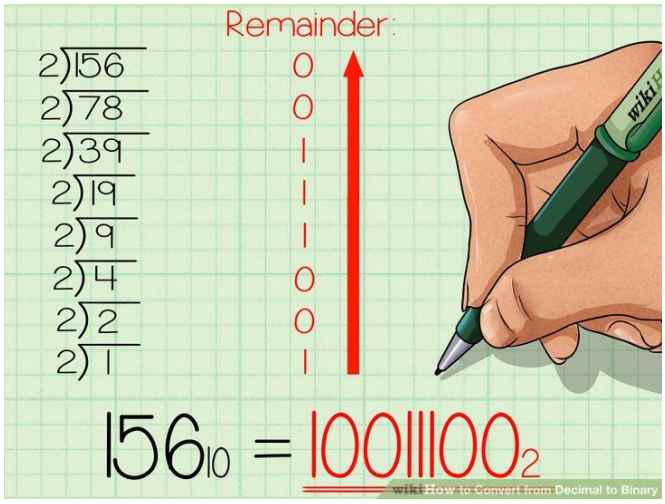
2. 

Divide. Write the integer answer (quotient) under the long division symbol, and write the remainder (0 or 1) to the right of the dividend.[2]

- Since we are dividing by 2, when the dividend is even the binary remainder will be 0, and when the dividend is odd the binary remainder will be 1.

3. 

Continue to divide until you reach 0. Continue downwards, dividing each new quotient by two and writing the remainders to the right of each dividend. Stop when the quotient is 0.

4. 

Write out the new, binary number. Starting with the bottom remainder, read the sequence of remainders upwards to the top. For this example, you should have 10011100. This is the binary equivalent of the decimal number 156. Or, written with base subscripts: $156_{10} = 10011100_2$

- This method can be modified to convert from decimal to *any* base. The divisor is 2 because the desired destination is base 2 (binary). If the desired destination is a different base, replace the 2 in the method with the desired base. For example, if the desired destination is base 9, replace the 2 with 9. The final result will then be in the desired base.

How to Convert from Binary to Decimal

Three Methods:ConverterUsing Positional NotationUsing DoublingCommunity Q&A

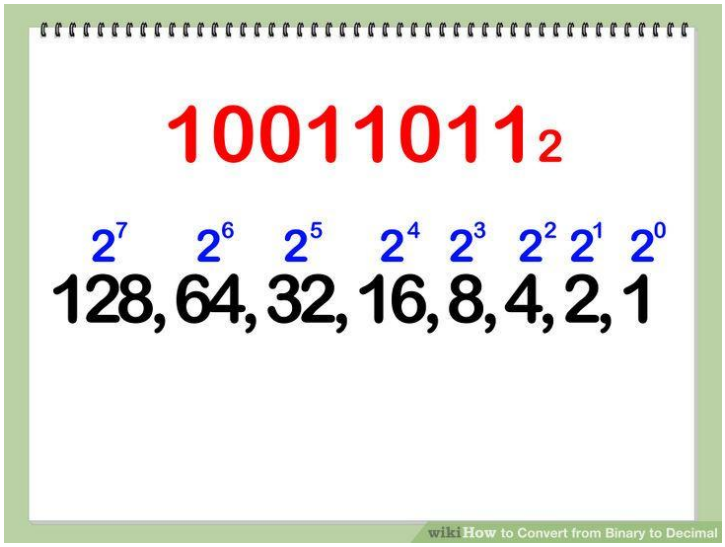
The binary ("base two") numerical system has two possible values, often represented as 0 or 1, for each place-value. In contrast, the decimal (*base ten*) numeral system has ten possible values (0,1, 2, 3, 4, 5, 6, 7, 8, or 9) for each place-value. To avoid confusion while using different numeral systems, the base of each individual number may be specified by writing it as a subscript of the number. For example, the binary number 10011100 may be specified as "base two" by writing it as 10011100_2. The decimal number 156 may be written as 156_{10} and read as "one hundred fifty-six, base ten". Since the binary system is the internal language of electronic computers, serious computer programmers should understand how to convert from binary to decimal. Converting in the opposite direction, from decimal to binary, is often more difficult to learn first.

Converter

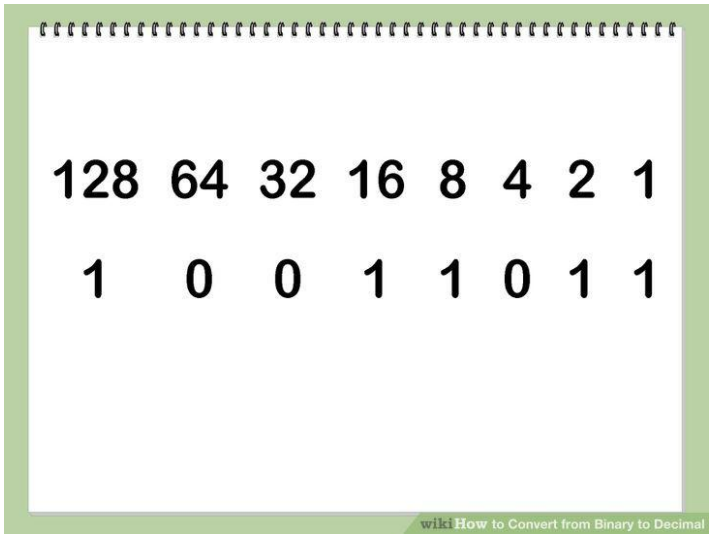
Binary to Decimal Converter

Method 1

Using Positional Notation

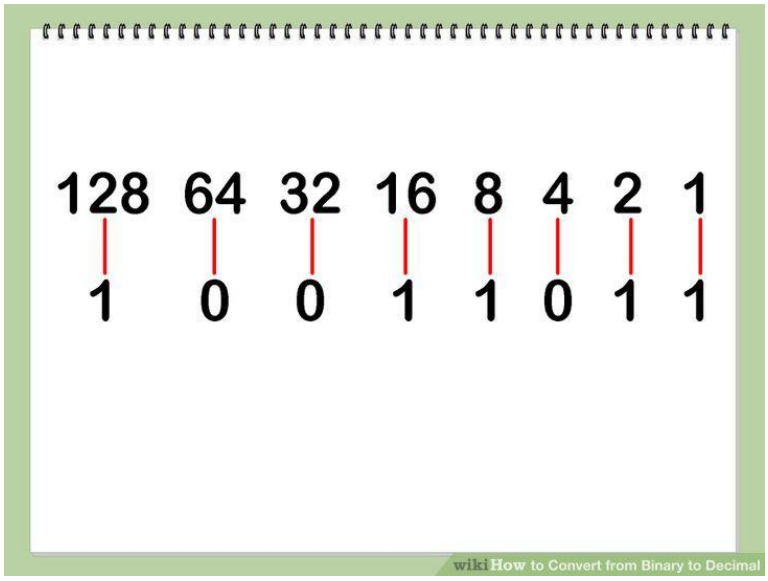
1. 

   Write down the binary number and list the powers of 2 from right to left. Let's say we want to convert the binary number 10011011_2 to decimal. First, write it down. Then, write down the powers of two from right to left. Start at 2^0, evaluating it as "1". Increment the exponent by one for each power. Stop when the amount of elements in the list is equal to the amount of digits in the binary number. The example number, 10011011, has eight digits, so the list, with eight elements, would look like this: 128, 64, 32, 16, 8, 4, 2, 1

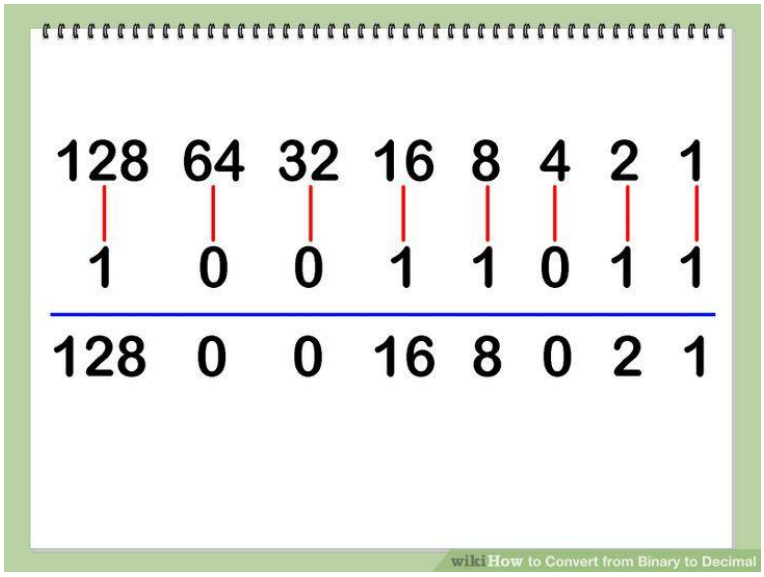
2. 

   Write the digits of the binary number below their corresponding powers of two. Now, just write 10011011 below the numbers 128, 64, 32, 16, 8, 4, 2, and 1 so that each binary digit corresponds with its power of two. The "1" to the right of the binary number should correspond

with the "1" on the right of the listed powers of two, and so on. You can also write the binary digits above the powers of two, if you prefer it that way. What's important is that they match up.

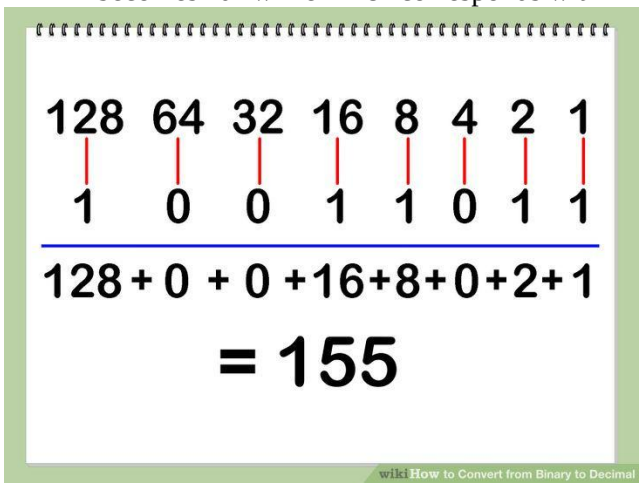
3. 

Connect the digits in the binary number with their corresponding powers of two. Draw lines, starting from the right, connecting each consecutive digit of the binary number to the power of two that is next in the list above it. Begin by drawing a line from the first digit of the binary number to the first power of two in the list above it. Then, draw a line from the second digit of the binary number to the second power of two in the list. Continue connecting each digit with its corresponding power of two. This will help you visually see the relationship between the two sets of numbers.

4. 

Write down the final value of each power of two. Move through each digit of the binary number. If the digit is a 1, write its corresponding power of two below the line, under the digit. If the digit is a 0, write a 0 below the line, under the digit.

- Since "1" corresponds with "1", it becomes a "1." Since "2" corresponds with "1," it becomes a "2." Since "4" corresponds with "0," it becomes "0." Since "8" corresponds with "1", it becomes "8," and since "16" corresponds with "1" it becomes "16." "32" corresponds with "0" and becomes "0" and "64" corresponds with "0" and therefore becomes "0" while "128" corresponds with "1" and becomes 128.

5. 

Add the final values. Now, add up the numbers written below the line. Here's what you do: 128 + 0 + 0 + 16 + 8 + 0 + 2 + 1 = 155. This is the decimal equivalent of the binary number 10011011.

Write the answer along with its base subscript. Now, all you have to do is write 155_{10}, to show that you are working with a decimal answer, which must be operating in powers of 10. The more you get used to converting from binary to decimal, the more easy it will be for you to memorize the powers of two, and you'll be able to complete the task more quickly.

6.

Use this method to convert a binary number with a decimal point to decimal form. You can use this method even when you want to covert a binary number such as 1.1_2 to decimal. All you have to do is know that the number on the left side of the decimal is in the units position, like normal, while the number on the right side of the decimal is in the "halves" position, or 1 x (1/2).

- The "1" to the left of the decimal point is equal to 2^0, or 1. The 1 to the right of the decimal is equal to 2^{-1}, or .5. Add up 1 and .5 and you get 1.5, which is 1.1_2 in decimal notation.

Web Surfing

: To move from place to place on internet searching for topics of interest. Web surfing has become a favorite pastime for many internet users.

Alternatively referred to as web surfing, surfing describes the act of browsing the internet by going from one web page to another web page using hyperlinks in an internet browser.

The term “Surfing” was first used by **Mark McCahill.**

Tip: When someone is surfing the internet they can be referred to as a **surfer** or **net surfer**.

Operating System

Operating Systems cab be accessed through two modes: **CLI** – Command Line Interface and **GUI**- Graphics User Interface.

Through the CLI mode, the interaction with the operating system environment is through typing commands at the command prompt; which through the GUI mode, the interaction is achieved through pictures and symbols.

An **operating system** is the **most important software** that runs on a computer. It manages the computer's **memory** and **processes**, as well as all of its **software** and **hardware**. It also allows you to **communicate** with the computer without knowing how to speak the computer's language. **Without an operating system, a computer is useless**.

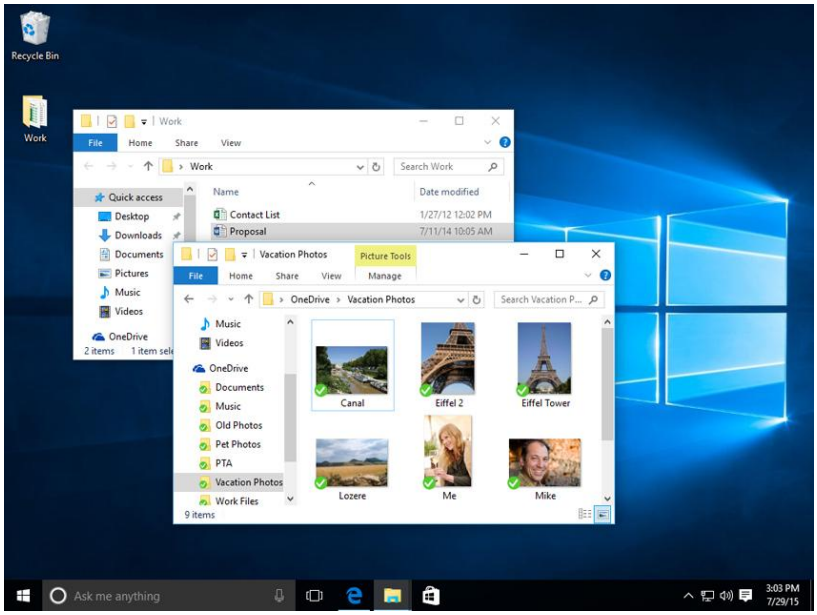
The operating system's job

Your computer's **operating system** (**OS**) manages all of the **software** and **hardware** on the computer. Most of the time, there are several different computer programs running at the same time, and they all need to access your computer's **central processing unit (CPU)**, **memory**, and **storage**. The operating system coordinates all of this to make sure each program gets what it needs.

Types of operating systems

Operating systems usually come **pre-loaded** on any computer you buy. Most people use the operating system that comes with their computer, but it's possible to upgrade or even change operating systems. The three most common operating systems for personal computers are **Microsoft Windows**, **Mac OS X**, and **Linux**.

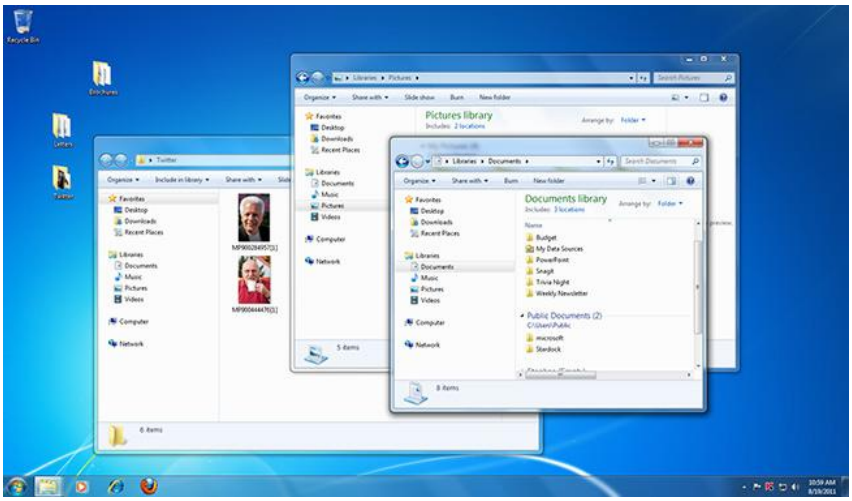
Modern operating systems use a **graphical user interface**, or **GUI** (pronounced **gooey**). A GUI lets you use your mouse to click **icons**, **buttons**, and **menus**, and everything is clearly displayed on the screen using a combination of **graphics** and **text**.



Each operating system's GUI has a different look and feel, so if you switch to a different operating system it may seem unfamiliar at first. However, modern operating systems are designed to be **easy to use**, and most of the basic principles are the same.

Microsoft Windows

Microsoft created the **Windows** operating system in the mid-1980s. Over the years, there have been many different versions of Windows, but the most recent ones are **Windows 10** (released in 2015), **Windows 8** (2012), **Windows 7** (2009), and **Windows Vista** (2007). Windows comes **pre-loaded** on most new PCs, which helps to make it the **most popular operating system** in the world.



Mac OS X

Mac OS is a line of operating systems created by Apple. It comes preloaded on all new Macintosh computers, or Macs. All of the recent versions are known as **OS X** (pronounced O-S Ten), and the specific versions include **El Capitan** (released in 2015), **Yosemite** (2014), **Mavericks** (2013), **Mountain Lion** (2012), and **Lion** (2011).

According to StatCounter Global Stats, Mac OS X users account for less than **10%** of global operating systems—much lower than the percentage of Windows users (more than **80%**). One reason for this is that Apple computers tend to be more expensive. However, many people do prefer the look and feel of Mac OS X over Windows.

Check out our tutorials on OS X Basics and specific OS X versions for more information.

Linux

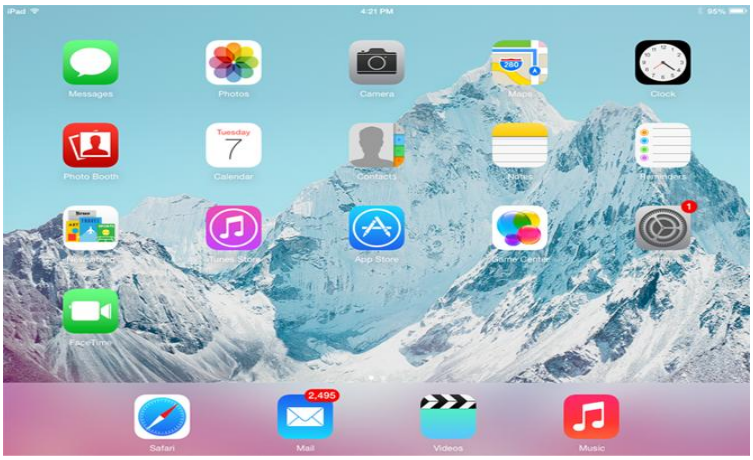
Linux (pronounced **LINN-ux**) is a family of **open-source** operating systems, which means they can be modified and distributed by anyone around the world. This is different from **proprietary software** like Windows, which can only be modified by the company that owns it. The advantages of Linux are that it is **free**, and there are many different **distributions**—or versions—you can choose from.

According to StatCounter Global Stats, Linux users account for less than **2%** of global operating systems. However, most **servers** run Linux because it's relatively easy to customize.

To learn more about different distributions of Linux, visit the Ubuntu, Linux Mint, and Fedora websites, or refer to our Linux Mint Resources. For a more comprehensive list, you can visit MakeUseOf's list of The Best Linux Distributions.

Operating systems for mobile devices

The operating systems we've been talking about so far were designed to run on **desktop** and **laptop** computers. **Mobile devices** such as **phones**, **tablet computers**, and **MP3 players** are different from desktop and laptop computers, so they run operating systems that are designed specifically for mobile devices. Examples of mobile operating systems include **Apple iOS** and **Google Android**. In the screenshot below, you can see iOS running on an iPad.



Operating systems for mobile devices generally aren't as fully featured as those made for desktop and laptop computers, and they aren't able to run all of the same software. However, you can still do a lot of things with them, like watch movies, browse the Web, manage your calendar, and play games.

WWW

The World Wide Web (abbreviated WWW or the Web) is an information space where documents and other web resources are identified by Uniform Resource Locator (URL) interlinked by hyperlinks and can be accessed via the internet. English scientist Tim Berners-Lee invented the World Wide Web in 1989. Remember WWW supports Multimedia computing: texts, videos, sounds etc.

HTTP

The **Hypertext Transfer Protocol (HTTP)** *is an application protocol for distributed, collaborative, hypermedia* information systems. Hypertext is structured text that uses logical links (hyperlinks) between nodes containing text. Development of HTTP was initiated by Tim Berners-Lee at CERN in 1989. HTTP is the foundation of data communication for the World Wide Web.

Now, HTTP is the underlying protocol used by the World Wide Web and this protocol defines how messages are formatted and transmitted and what actions web servers and browsers should take in response to various commands.

Search Engines

It is a web-based tool or software program/system that is designed to search for information on the World Wide Web. The program searches for and identifies items in a database that corresponds to keywords or characters specified by user, used specifically in finding particular sites on the Web.

List Of Some Best Search Engines

- Google
- Bing
- Yahoo
- Baidu
- AOL
- Ask.com
- Excite
- DuckDuckGo

Social, Ethical Issues and Professional Issues in Computing.

Ten Commandments of Computer Ethics

1. Thou shalt not use a computer to harm other people.
2. Thou shalt not interfere with other people's computer work.
3. Thou shalt not snoop around in other people's computer files.
4. Thou shalt not use a computer to steal.
5. Thou shalt not use a computer to bear false witness.
6. Thou shalt not copy or use proprietary software for which you have not paid (without permission).
7. Thou shalt not use other people's computer resources without authorization or proper compensation.
8. Thou shalt not appropriate other people's intellectual output.
9. Thou shalt think about the social consequences of the program you are writing or the system you are designing.
10. Thou shalt always use a computer in ways that ensure consideration and respect for your fellow humans