Computer Sciences

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2020 - 2021

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Chapter One
Computer Basics

1. Computer Science

The science that deals with the theory and methods of processing information in digital computers, the design of computer hardware and software, and the applications of computers. The discipline of computer science includes the study of algorithms and data structures, computer and network design, modeling data and information processes, and artificial intelligence. Computer science draws some of its foundations from mathematics and engineering and therefore incorporates techniques from areas such as queueing theory, probability and statistics, and electronic circuit design. Computer science also makes heavy use of hypothesis testing and experimentation during the conceptualization, design, measurement, and refinement of new algorithms, information structures, and computer architectures.

An algorithm is a detailed and unambiguous sequence of actions for solving a problem or for performing some task. Algorithms are essential to the way computers process information because a computer program is basically just an algorithm that tells the computer what specific steps to perform (and in what sequence) in order to carry out a specified task.

Principal areas of study within Computer Science include artificial intelligence, computer systems and networks, security, database systems, human computer interaction, vision and graphics, numerical analysis, programming languages, software engineering, bioinformatics and theory of computing.

2. Basics of Computer

In today's world, we use computers for all our tasks. Our day-to-day activities: paying bills, buying groceries, using social media, seeking entertainment, working from home, communicating with a friend, etc., can all be done using a computer. So, it is important not only to know how to use a computer, but also to understand the components of a computer and what they do.

This topic explains all concepts related to computer in detail, from origin to end. The idea of computer literacy is also discussed, which includes the definition and functions of a computer and learn about the components of a computer, the concept of hardware and software, representation of data/information, the concept of data processing and applications of Information.

2.1   What is a Computer?

A **computer** is an electronic device that accepts data from the user, processes it, produces results, displays them to the users, and stores the results for future usage.

Data is a collection of unorganized facts and figures and does not provide any further information regarding patterns, context, etc. Hence data means "unstructured facts and figures".

Information is a structured data i.e., organized meaningful and processed data. To process the data and convert into information, a computer is used.

Figure 1: Computer

2.2   Functions of Computer

A computer performs the following functions:

1. Receiving Input
Data is fed into computer through various input devices like keyboard, mouse, digital pens, etc. Input can also be fed through devices like CD-ROM, pen drive, scanner, etc.

2. Processing the data
Operations on the input data are carried out based on the instructions provided in the programs.

3. Storing the information
After processing, the information gets stored in the primary or secondary storage area.

4. Producing output
The processed information and other details are communicated to the outside world through output devices like monitor, printer, etc.
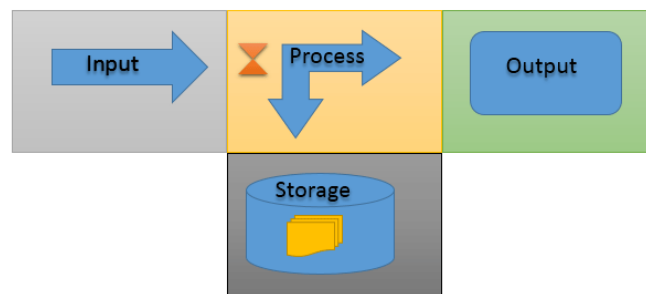
Figure 2: Functions of Computer

2.3   History of Computers

Computer generations are based on when major technological changes in computers occurred, like the use of vacuum tubes, transistors, and the microprocessor. As of 2020, there are five generations of the computer. The history of the computer dates back to several years. There are five prominent generations of computers. Each generation has witnessed several technological advances which change the functionality of the computers. This results in more compact, powerful, robust systems which are less expensive.

The brief history of computers is discussed in the next page.

A. First Generation (1940 - 1956)

The first generation of computers used **vacuum tubes** as a major piece of technology. Vacuum tubes were widely used in computers from 1940 through 1956. Vacuum tubes were larger components and resulted in first generation computers being quite large in size, taking up a lot of space in a room. Some of the first-generation computers took up an entire room. The ENIAC is a great example of a first-generation computer. It consisted of nearly 20,000 vacuum tubes, as well as 10,000 capacitors and 70,000 resistors. It weighed over 30 tons and took up a lot of space, requiring a large room to house it. Other examples of first generation computers include the EDSAC, IBM 701, and Manchester Mark 1.

Figure 3: Vacuum tubes

B. Second Generation (1956 - 1963)

The second generation of computers saw the use of **transistors** instead of vacuum tubes. Transistors were widely used in computers from 1956 to 1963. Transistors were smaller than vacuum tubes and allowed computers to be smaller in size, faster in speed, and cheaper to build. The first computer to use transistors was the TX-0 and was introduced in 1956. Other computers that used transistors include the IBM 7070, Philco Transac S-1000, and RCA 501.

Figure 4: Transistors

C. Third Generation (1964 - 1971)

The third generation of computers introduced the use of **IC (integrated circuits)** in computers. Using IC's in computers helped reduce the size of computers even more compared to second-generation computers, as well as make them faster.

Nearly all computers since the mid to late 1960s have utilized IC's. While the third generation is considered by many people to have spanned from 1964 to 1971, IC's are still used in computers today. Over 45 years later, today's computers have deep roots going back to the third generation.
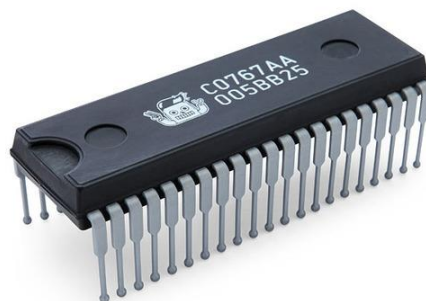

Figure 5: Integrated circuits

D. Fourth Generation (1972-2010)

The fourth generation of computers took advantage of the invention of the **microprocessor**, more commonly known as a CPU. Microprocessors, along with integrated circuits, helped make it possible for computers to fit easily on a desk and for the introduction of the laptop. Some of the earliest computers to use a microprocessor include the Altair 8800, IBM 5100, and Micral. Today's computers still use a microprocessor, despite the fourth generation being considered to have ended in 2010.
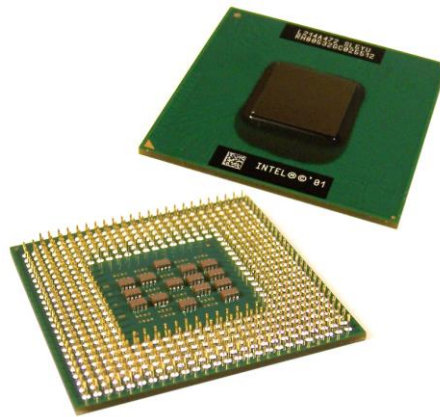

Figure 6: Microprocessor

E. Fifth Generation (2010-Present)

The fifth generation of computers is beginning to use **AI (artificial intelligence)**, an exciting technology that has many potential applications around the world. Leaps have been made in AI technology and computers, but there is still room for much improvement.
One of the more well-known examples of AI in computers is IBM's Watson, which was featured on the TV show Jeopardy as a contestant. Other better-known examples include Apple's Siri on the iPhone and Microsoft's Cortana on Windows 8 and Windows 10 computers. The Google search engine also utilizes AI to process user searches.
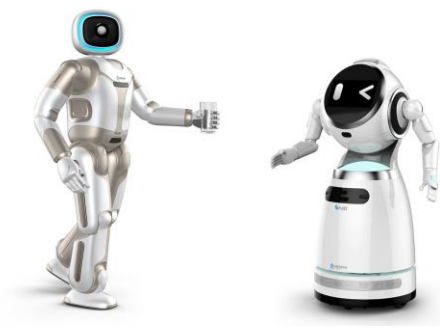

Figure 7: Robots

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2.4   Characteristics of Computer System

The characteristics of the computer system are as follows −

2.4.1 Speed

A computer works with much higher speed and accuracy compared to humans while performing mathematical calculations. Computers can process millions (1,000,000) of instructions per second. The time taken by computers for their operations is microseconds and nanoseconds.

2.4.2 Accuracy

Computers perform calculations with 100% accuracy. Errors may occur due to data inconsistency or inaccuracy.

2.4.3 Diligence

A computer can perform millions of tasks or calculations with the same consistency and accuracy. It doesn't feel any fatigue or lack of concentration. Its memory also makes it superior to that of human beings.

2.4.4 Versatility

Versatility refers to the capability of a computer to perform different kinds of works with same accuracy and efficiency.

2.4.5 Reliability

A computer is reliable as it gives consistent result for similar set of data i.e., if we give same set of input any number of times, we will get the same result.

2.4.6 Automation

Computer performs all the tasks automatically i.e., it performs tasks without manual intervention.

2.4.7 Memory

A computer has built-in memory called primary memory where it stores data. Secondary storage are removable devices such as CDs, pen drives, etc., which are also used to store data.

2.5   Basic Applications of Computer

Computers play a role in every field of life. They are used in homes, business, educational institutions, research organizations, medical field, government offices, entertainment, etc.

2.5.1 Home

Computers are used at homes for several purposes like online bill payment, watching movies or shows at home, home tutoring, social media access, playing games, internet access, etc. They provide communication through electronic mail. They help to avail work from home facility for corporate employees. Computers help the student community to avail online educational support.

2.5.2 Medical Field

Computers are used in hospitals to maintain a database of patients' history, diagnosis, X-rays, live monitoring of patients, etc. Surgeons nowadays use robotic surgical devices to perform delicate operations, and conduct surgeries remotely. Virtual reality technologies are also used for training purposes. It also helps to monitor the fetus inside the mother's womb.

2.5.3 Entertainment

Computers help to watch movies online, play games online; act as a virtual entertainer in playing games, listening to music, etc. Videos can be fed from computers to full screen televisions. Photo editors are available with fabulous features.

2.5.4 Industry

Computers are used to perform several tasks in industries like managing inventory, designing purpose, creating virtual sample products, interior designing, video conferencing, etc. Online marketing has seen a great revolution in its ability to sell various products to inaccessible corners like interior or rural areas. Stock markets have seen phenomenal participation from different levels of people through the use of computers.

2.5.5 Education

Computers are used in education sector through online classes, online examinations, referring e-books, online tutoring, etc. They help in increased use of audio-visual aids in the education field.

2.5.6 Government

In government sectors, computers are used in data processing, maintaining a database of citizens and supporting a paperless environment. The country's defense organizations have greatly benefitted from computers in their use for missile development, satellites, rocket launches, etc.

2.5.7 Banking

In the banking sector, computers are used to store details of customers and conduct transactions, such as withdrawal and deposit of money through ATMs. Banks have reduced manual errors and expenses to a great extent through extensive use of computers.

2.5.8 Business

Nowadays, computers are totally integrated into business. The main objective of business is transaction processing, which involves transactions with suppliers, employees or customers. Computers can make these transactions easy and accurate. People can analyze investments, sales, expenses, markets and other aspects of business using computers.

2.5.9 Training

Many organizations use computer-based training to train their employees, to save money and improve performance. Video conferencing through computers allows saving of time and travelling costs by being able to connect people in various locations.

2.5.10 Arts

Computers are extensively used in dance, photography, arts and culture. The fluid movement of dance can be shown live via animation. Photos can be digitized using computers.

2.5.11 Science and Engineering

Computers with high performance are used to stimulate dynamic process in Science and Engineering. Topographic images can be created through computers.

3. Computer Types

Computers can be broadly classified by their speed and computing power.

a. PC (Personal Computer)

A PC can be defined as a small, relatively inexpensive computer designed for an individual user. PCs are based on the microprocessor technology that enables manufacturers to put an entire CPU on one chip. Businesses use personal computers for word processing, accounting, desktop publishing, and for running spreadsheet and database management applications. At home, the most popular use for personal computers is playing games and surfing the Internet.

Figure 8: Personal Computer

b. Workstation

A workstation is a special computer designed for technical or scientific applications. Workstations offer higher performance than mainstream personal computers, especially with respect to CPU and graphics, memory capacity, and multitasking capability. Workstations are optimized for the visualization and manipulation of different types of complex data such as 3D mechanical design, engineering simulation (e.g., computational fluid dynamics), animation and rendering of images.

Figure 9: Workstation

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c. Minicomputer

Minicomputer, Computer that is smaller, less expensive, and less powerful than a mainframe or supercomputer, but more expensive and more powerful than a personal computer. Minicomputers are used for scientific and engineering computations, business-transaction processing, file handling, and database management, and are often now referred to as small or midsize servers.

Figure 10: Minicomputer

d. Mainframe

Mainframe is very large in size and is an expensive computer capable of supporting hundreds or even thousands of users simultaneously. Mainframe executes many programs concurrently and supports many simultaneous executions of programs.

Figure 11: Mainframe

e. Supercomputer

Supercomputers are one of the fastest computers currently available. Supercomputers are very expensive and are employed for specialized applications that require immense amount of mathematical calculations (number crunching).

For example, weather forecasting, scientific simulations, (animated) graphics, fluid dynamic calculations, nuclear energy research, electronic design, and analysis of geological data (e.g. in petrochemical prospecting).

Figure 12: Supercomputer

S.No.	Type	Specifications
1	PC (Personal Computer)	It is a single user computer system having moderately powerful microprocessor
2	Workstation	It is also a single user computer system, similar to personal computer however has a more powerful microprocessor.
3	Minicomputer	It is a multi-user computer system, capable of supporting hundreds of users simultaneously.
4	Mainframe	It is a multi-user computer system, capable of supporting hundreds of users simultaneously. Software technology is different from minicomputer.
5	Supercomputer	It is an extremely fast computer, which can execute hundreds of millions of instructions per second.

4. Components of Computer system

Every computer is composed of two basic components: **Hardware** and **Software**.

A. **Computer hardware** is the umbrella term used to describe the physical collection of elements that complete a whole computer system. Hardware encompasses the external tools that allow users to operate a computer, such as the keyboard, mouse and the monitor, and internal components like the motherboard, graphics card, and hard disc.

B. **Computer software** is the term used to define the sets of code, data, and instructions stored on the computer's hard drive that operate the machine from behind the scenes. In other words, software allows a computer to actually perform tasks, without software, computer hardware would be entirely useless.

4.1   Computer Hardware

The term **'Computer hardware'** or **'Computer parts'** is used to describe the physical and tangible components of a computer, i.e. the components that can be seen and touched.

Examples of Hardware are the following:

*   **Input devices** − keyboard, mouse, etc.

*   **Output devices** − printer, monitor, etc.

*   **Internal components** − CPU, motherboard, Memory, etc.

*   **Secondary storage devices** − Hard disk, CD, DVD, etc.

Figure 13: Computer hardware

4.1.1 Input Devices (Input Unit)

Input unit is used for transfers' raw Data and control signals into the information processing system by the user before processing and computation. All the input unit devices provide the instructions and data are transformed into binary codes that is the primary memory acceptable format.

Example of Input unit devices: keyboard, mouse, scanner, joystick, Magnetic tape etc.

Input Devices	Characteristics	Image
Keyboard	The keyboard was first peripheral device to be used with computers. It helps to input text and numbers into computer. It consists of 104 keys and 12 functional keys.	
Mouse	A mouse is an input device which is also called as pointing device because it helps to point data on screen. It also helps to select, highlight content and drag-drop controls.	
Trackballs	A trackball is also a pointing device which will work like a mouse. It is mainly used for gaming and entertainment purpose.	
Digital Pens	A digital pen is another input device which is mostly used with tablets, PDAs, etc. A digital pen is also called as a Stylus which helps to write or draw data over pad.	
Scanners	Scanners transform printed material and photographs into a digital representation. After scanning of printed material, page is represented in memory as an array of pixels.	
Barcode Readers	Barcode reader helps to read information which is printed as bars in back of goods or items.	
Voice Recognition System	Voice recognition system interprets or receives dictation or spoken commands to authorize user.	
Touch screen	A touch screen is an input device which uses sensors to sense touch of users to get input data.	

4.1.2 Output Devices

Output devices help to display output to user. Some of output devices are:

Output Devices	Characteristics	Image
Monitor	A monitor is most common type of output device. It is also called as "Visual Display Unit". The inputs given by keyboard or any other input devices will get displayed on monitor.	
Printers	Printers are most common type of output devices which are used to take a hard copy of any digital document. The two types of printers are impact and non-impact printers. Non-impact printers such as laser and inkjet printers are less noisy, more reliable and faster and also offer high quality compared to impact printers.	
Sound Systems	Sound systems are output devices which are used to get multimedia content such as voice, music, etc., as output. Some of examples of sound systems are speakers, headphones, and microphones.	

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4.1.3 Internal Components

A. Central Processing Unit

The Central Processing Unit (CPU) is called "the brain of computer" as it controls operation of all parts of computer. CPU consists of two components: Arithmetic Logic Unit (ALU), and Control Unit (CU).
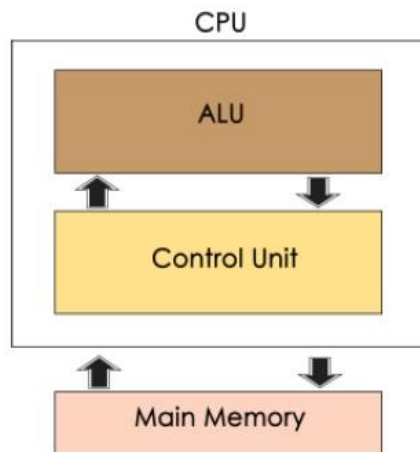

Figure 14: Central Processing Unit

a. Arithmetic Logic Unit (ALU)

An arithmetic logic unit (ALU) is a digital circuit used to perform arithmetic and logic operations. It represents the fundamental building block of the central processing unit (CPU) of a computer. Modern CPUs contain very powerful and complex ALUs. In addition to ALUs, modern CPUs contain a control unit (CU). Most of the operations of a CPU are performed by one or more ALUs, which load data from input registers.

b. Control Unit

A control unit works by receiving input information that it converts into control signals, which are then sent to the central processor. The computer's processor then tells the attached hardware what operations to carry out. The functions that a control unit performs are dependent on the type of CPU, due to the variance of architecture between different manufacturers.

The following diagram illustrates how instructions from a program are processed.
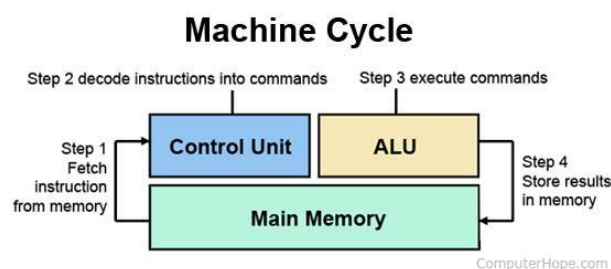
Figure 15: control unit work

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Functions of Control Unit

Control unit performs following functions −

- It controls all activities of computer
- Supervises flow of data within CPU
- Directs flow of data within CPU
- Transfers data to Arithmetic and Logic Unit
- Transfers results to memory
- Fetches results from memory to output devices

c. Memory Unit

This is unit in which data and instructions given to computer as well as results given by computer are stored. Unit of memory is "Byte".

Computer memory is measured in terms of how many bits it can store. Here is a chart for memory capacity conversion.

1 byte (B) = 8 bits
1 Kilobytes (KB) = 1024 bytes
1 Megabyte (MB) = 1024 KB
1 Gigabyte (GB) = 1024 MB
1 Terabyte (TB) = 1024 GB
1 Exabyte (EB) = 1024 TB
1 Zettabyte = 1024 EB
1 Yottabyte (YB) = 1024 ZB

B. Motherboard

The motherboard serves as a single platform to connect all of the parts of a computer together. It connects the CPU, memory, hard drives, optical drives, video card, sound card, and other ports and expansion cards directly or via cables. It can be considered as the backbone of a computer.

Figure 16: Motherboard

The motherboard is mounted inside the case and is securely attached via small screws through pre-drilled holes. Motherboard contains ports to connect all of the internal components. It provides a single socket for CPU, whereas for memory, normally one or more slots are available. Motherboards provide ports to attach the floppy drive, hard drive, and optical drives via ribbon cables. Motherboard carries fans and a special port designed for power supply.

There is a peripheral card slot in front of the motherboard using which video cards, sound cards, and other expansion cards can be connected to the motherboard.

On the left side, motherboards carry a number of ports to connect the monitor, printer, mouse, keyboard, speaker, and network cables. Motherboards also provide USB ports, which allow compatible devices to be connected in plug-in/plug-out fashion. For example, pen drive, digital cameras, etc.

C. Computer Memory

Computer memory refers to storage area where data is stored. It is of two types:-

- Primary Memory
- Secondary Memory
- Cash Memory

a. Primary Memory

Primary memory is the main memory of computer present in motherboard. Primary memory is of two types as shown in the image below.
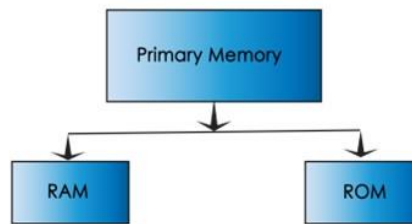

Figure 17: Computer Memory

i.   Random Access Memory

Alternatively referred to as main memory, primary memory, or system memory, RAM (random-access memory) is a hardware device that allows information to be stored and retrieved on a computer. Because data is accessed randomly instead of sequentially like it is on a CD or hard drive, access times are much faster. However, unlike ROM, RAM is a volatile memory and requires power to keep the data accessible. If the computer is turned off, all data contained in RAM is lost.

Figure 18: RAM

Functions of RAM are as follows:

- It stores data till it gets processed.
- It stores instructions for data processing.
- It acts as a working space where data processing takes place and intermediate results are stored.
- It stores processed data/results before it is sent to output devices.

ii.   Read Only Memory

ROM is referred as permanent memory, in which information stored is available even if computer is turned off. Instructions stored in this memory can only be read and cannot be modified. Mostly ROM has a start-up instruction which is executed every time when computer is switched on. Types of ROM are PROM (Programmable Read Only Memory), EPROM (Erasable PROM), EEPROM (Electrically Erasable PROM).

The below table jots down the major differences between RAM and ROM: -

Figure 19: ROM

Sr.No	RAM	ROM
1	It is volatile memory.	It is non-volatile memory.
2	The contents are temporary; data is lost when electricity supply is lost.	The contents are permanent; data is not lost even when power is switched off.
3	Available in small storage capacity.	Available in high storage capacity.
4	Processing speed is high.	Processing speed is low.
5	User-defined programs can be stored.	Generally, operating system supporting programs can be stored.
6	Cost is very high.	Cost effective.
7	It is of two types, SRAM and DRAM.	It comes in different types such as PROM, EPROM, EEPROM and flash memory.

b. Secondary Memory

Secondary memory refers to storage devices, such as hard drives and solid-state drives. It may also refer to removable storage media, such as USB flash drives, CDs, and DVDs.

Unlike primary memory, secondary memory is not accessed directly by the CPU. Instead, data accessed from secondary memory is first loaded into RAM and is then sent to the processor. The RAM plays an important intermediate role, since it provides much faster data access speeds than secondary memory. By loading software programs and files into primary memory, computers can process data much more quickly.

Figure 20: Secondary Memory

While secondary memory is much slower than primary memory, it typically offers far greater storage capacity. For example, a computer may have a one terabyte hard drive, but only 16 gigabytes of RAM. That means the computer has roughly 64 times more secondary memory than primary memory. Additionally, secondary memory is non-volatile, meaning it retains its data with or without electrical power. RAM, on the other hand, is erased when a computer is shut down or restarted. Therefore, secondary memory is used to store "permanent data," such as the operating system, applications, and user files.

c. Cache memory

Cache memory, also called Cache, a supplementary memory system that temporarily stores frequently used instructions and data for quicker processing by the central processor of a computer. The cache augments, and is an extension of, a computer's main memory. Both main memory and cache are internal, random-access memories (RAMs) that use semiconductor-based transistor circuits. Cache holds a copy of only the most frequently used information or program codes stored in the main memory; the smaller capacity of the cache reduces the time required to locate data within it and provide it to the computer for processing.

4.1.4 Secondary storage devices

Secondary storage is where data software can be stored on permanent basis. The data on secondary memory stays there until it is deleted or overwritten by the user. There are three types of secondary storage devices. They are:

1. Magnetic.
2. Optical.
3. Solid state storage.

Figure 21: Secondary storage devices

The most commonly used magnetic storage device is hard drive. There are primarily three types of optical storage devices, CD (compact disk), DVD (digital video disk) and BD (blue ray disk). CDs can hold about 700 MB data DVD can hold about 4.7 GB data and Blue ray disk can have 5 times the storage of DVD.

Solid state storage devices are becoming more and more popular and they are replacing disk drives (both magnetic and optic). They require less energy and quieter. Some examples of solid-state devices are flash memory devices, pen drive, SD card etc. They can store data from few gigabytes to up to 128 GB.

4.2   Computer - Software

Software is a set of programs, which is designed to perform a well-defined function. A program is a sequence of instructions written to solve a particular problem.

There are two types of software: -

- **System Software**
- **Application Software**

4.2.1 System Software

The system software is a collection of programs designed to operate, control, and extend the processing capabilities of the computer itself. System software is generally prepared by the computer manufacturers. These software products comprise of programs written in low-level languages, which interact with the hardware at a very basic level. System software serves as the interface between the hardware and the end users.

Some examples of system software are Operating System, Compilers, Interpreter, Assemblers, etc.

- **Operating System**

An Operating System (OS) is the most important software that runs on a computer. OS acts as an interface between the user and the computer hardware and controls the execution of all kinds of programs which is performs all the basic tasks like file management, memory management, process management, handling input and output, and controlling peripheral devices such as disk drives and printers. 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 is a program with the following features −

- An operating system is a program that acts as an interface between the software and the computer hardware.

- It is an integrated set of specialized programs used to manage overall resources and operations of the computer.

- It is a specialized software that controls and monitors the execution of all other programs that reside in the computer, including application programs and other system software.

Figure 22: System Software

4.2.2 Application Software

Application software products are designed to satisfy a particular need of a particular environment. All software applications prepared in the computer lab can come under the category of Application software.

Application software may consist of a single program, such as Microsoft's notepad for writing and editing a simple text. It may also consist of a collection of programs, often called a software package, which work together to accomplish a task, such as a spreadsheet package.
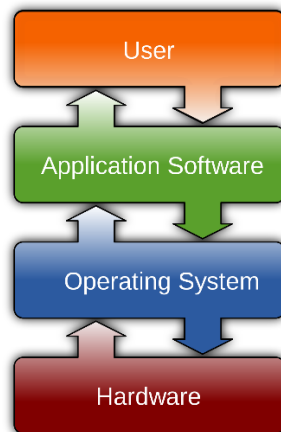
Figure 23: Application Software Location

Examples of Application software are the following: -

- Payroll Software
- Student Record Software
- Inventory Management Software
- Income Tax Software
- Railways Reservation Software
- Microsoft Office Suite Software
- Microsoft Word
- Microsoft Excel
- Microsoft PowerPoint

Figure 24: Application software

Features of application software are as follows: -

- Close to the user
- Easy to design
- More interactive
- Generally written in high-level language
- Easy to understand
- Easy to manipulate and use

Sr.No.	Software	Hardware
1	It is a collection of programs to bring computer hardware system into operation.	It includes physical components of computer system.
2	It includes numbers, alphabets, alphanumeric symbols, identifiers, keywords, etc.	It consists of electronic components like ICs, diodes, registers, crystals, boards, insulators, etc.
3	Software products evolve by adding new features to existing programs to support hardware.	Hardware design is based on architectural decisions to make it work over a range of environmental conditions and time.
4	It will vary as per computer and its built-in functions and programming language.	It is mostly constructed for all types of computer systems.
5	It is designed and developed by experienced programmers in high-level language.	The hardware can understand only low-level language or machine language.
6	It is represented in any high-level language such as BASIC, COBOL, C, C++, JAVA, etc.	The hardware works only on binary codes 1's and 0's.
7	The software is categorized as operating system, utilities, language processor, application software, etc.	The hardware consists of input devices, output devices, memory, etc.

5. Computer Numbering Systems

In computers, Number System is defined as a writing system to represent the numbers in different ways i.e., we are using different symbols and notations to represent numbers. There are four ways we can represent the number.

Computer architecture supports following number systems.

- Binary number system
- Decimal number system
- Octal number system
- Hexadecimal (hex) number system

1. Binary Number System

Binary Number System is a number system in which we represent the numbers by using only two symbols i.e. 0 or 1. The binary system is applied internally by almost all latest computers and computer-based devices because of its direct implementation in electronic circuits using logic gates. Every digit is referred to as a bit.

Example
Binary Number: 10101_2
Calculating Decimal Equivalent:

Step	Binary Number	Decimal Number
Step 1	10101_2	$((1 \times 2^4) + (0 \times 2^3) + (1 \times 2^2) + (0 \times 2^1) + (1 \times 2^0))_{10}$
Step 2	10101_2	$(16 + 0 + 4 + 0 + 1)_{10}$
Step 3	10101_2	21_{10}

Note − 10101_2 is normally written as 10101.

2. Decimal Number System

In decimal number system we have 10 digits – 0 to 9 to represent the numbers. Hence, the base value of the Decimal Number system is 10. Decimal number system is used when there are 10 possible outputs of a system. For example, top 10 students from a class.

The number system that we use in our day-to-day life is the decimal number system. Decimal number system has base 10 as it uses 10 digits from 0 to 9. In decimal number system, the successive positions to the left of the decimal point represent units, tens, hundreds, thousands, and so on.

Each position represents a specific power of the base (10). For example, the decimal number 1234 consists of the digit 4 in the unit's position, 3 in the tens position, 2 in the hundreds position, and 1 in the thousands position. Its value can be written as

$(1 \times 1000) + (2 \times 100) + (3 \times 10) + (4 \times 1)$

$(1 \times 10^3) + (2 \times 10^2) + (3 \times 10^1) + (4 \times 10^0)$

$1000 + 200 + 30 + 4$

1234

- **Decimal to Binary and Binary to Decimal Number System**

Let us convert decimal number $(13728)_{10}$ to binary number.

DECIMAL TO BINARY CONVERSION

Base of Binary	Decimal Number	Remainder	
2	13728	0	LSB
2	6864	0	
2	3432	0	
2	1716	0	
2	858	0	
2	429	0	
2	214	1	
2	107	0	
2	53	1	
2	26	1	
2	13	0	
2	6	1	
	3	0	MSB

$(13728)_{10} = (0101101000000)_2$

So, in the above example. We first identified 2 is the base of the binary (target number system). Then, we divided the given decimal number 13728 with the base 2. And then we noted the remainder in every step. And finally, we reversed the remainder and got the answer –

$(0101101000000)_2$.

Let us convert binary number $(1011001)_2$ to decimal number.

Binary to Decimal

2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1024	512	256	128	64	32	16	8	4	2	1

				1	0	1	1	0	0	1

$1011001_2 = 1 \times 64 + 1 \times 16 + 1 \times 8 + 1 \times 1 = 89$

3. Octal Number System

Characteristics of the octal number system are as follows −

- Uses eight digits, 0,1,2,3,4,5,6,7

- Also called as base 8 number system

Example

Octal Number: 12570_8

Calculating Decimal Equivalent:

Step	Octal Number	Decimal Number
Step 1	12570_8	$((1 \times 8^4) + (2 \times 8^3) + (5 \times 8^2) + (7 \times 8^1) + (0 \times 8^0))_{10}$
Step 2	12570_8	$(4096 + 1024 + 320 + 56 + 0)_{10}$
Step 3	12570_8	5496_{10}

Note − 12570_8 is normally written as 12570.

4. Hexadecimal Number System

Characteristics of hexadecimal number system are as follows −

- Uses 10 digits and 6 letters, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F

- Letters represent the numbers starting from 10. A = 10. B = 11, C = 12, D = 13, E = 14, F = 15

- Also called as base 16 number system

- Each position in a hexadecimal number represents a **0** power of the base (16). Example, 16^0

- Last position in a hexadecimal number represents a **x** power of the base (16). Example 16^x where **x** represents the last position - 1

Example

Hexadecimal Number: $19FDE_{16}$

Calculating Decimal Equivalent: -

Step	Binary Number	Decimal Number
Step 1	$19FDE_{16}$	$((1 \times 16^4) + (9 \times 16^3) + (F \times 16^2) + (D \times 16^1) + (E \times 16^0))_{10}$
Step 2	$19FDE_{16}$	$((1 \times 16^4) + (9 \times 16^3) + (15 \times 16^2) + (13 \times 16^1) + (14 \times 16^0))_{10}$
Step 3	$19FDE_{16}$	$(65536 + 36864 + 3840 + 208 + 14)_{10}$
Step 4	$19FDE_{16}$	106462_{10}

Note − $19FDE_{16}$ is normally written as 19FDE.

6. Programming Languages

A **program** is a set of instructions that help computer to perform tasks. This set of instructions is also called as scripts. Programs are executed by processor whereas scripts are interpreted. The languages that are used to write a program or set of instructions are called "**Programming languages**". Programming languages are broadly categorized into three types −

- Machine level language
- Assembly level language
- High-level language

1. Machine Level Language

Machine language is lowest level of programming language. It handles binary data i.e., **0's** and **1's**. It directly interacts with system. Machine language is difficult for human beings to understand as it comprises combination of 0's and 1's. There is software which translate programs into machine level language. Examples include operating systems like Linux, UNIX, Windows, etc. In this language, there is no need of compilers and interpreters for conversion and hence the time consumption is less. However, it is non-readable to humans.

```
0001111100001010101
0011100111001101010
0101010101010000000
1010101010101010101
1010100000111110000
1010101000111000101
1010101010010100100
```

2. Assembly Level Language

Assembly language is a middle-level language. It consists of a set of instructions in a specific format called **commands**. It uses symbols to represent field of instructions. It is very close to machine level language. The computer should have assembler to translate assembly level program to machine level program. Examples include ADA, PASCAL, etc. It is in human-readable format and takes lesser time to write a program and debug it. However, it is a machine dependent language.

Assembly Language	Machine Code
SUB AX, BX	0010101110000011
MOV CX, AX	100010111001000
MOV DX, 0	1011101000000000000000

3. High-level Language

High-level language uses format or language that is most familiar to users. The instructions in this language are called **codes** or **scripts**. The computer needs a compiler and interpreter to convert high-level language program to machine level language. Examples include C++, Python, Java, etc. It is easy to write a program using high level language and is less time-consuming. Debugging is also easy and is a human-readable language. Main disadvantages of this are that it takes lot of time for execution and occupies more space when compared to Assembly- or Machine-level languages. Following is a simple example for a high-level language.

```
if age < 18 {
  printf("You are not eligible to vote");
} else {
  printf("You are eligible to vote");
}
```

7. Information Technology

Information technology (IT) is the use of any computers, storage, networking and other physical devices, infrastructure and processes to create, process, store, secure and exchange all forms of electronic data. Typically, IT is used in the context of enterprise operations as opposed to personal or entertainment technologies. The commercial use of IT encompasses both computer technology and telephony.

Information Technology (IT) is a business sector that deals with computing, including hardware, software, telecommunications and generally anything involved in the transmittal of information or the systems that facilitate communication. IT typically refers to equipment such as computers, data storage devices, networks and also communication devices. Information Technology means the use of hardware, software, services and supporting infrastructure to manage and deliver information using voices, data and video. Information Technology "IT" is one of the fastest growing industry in today's unstable economy. Why? Because many businesses, Government organizations, Industries want to automate their business and day-to-day processes.

1.2.1 Information Technology Examples

1. Software and support for office automation systems such as word processing and spreadsheets, as well as the computer to run them.
2. Data networks and all associated communications equipment such as servers, bridges, routers, hubs and wiring.
3. Peripherals directly connected to computer information systems used to collect or transmit audio, video or graphic information, such as scanners and digitizers.
4. Voice response systems that interact with a computer database or application.
5. Video conferencing equipment.
6. The state radio communications network.
7. Computers and network systems used by teachers, trainers and students for educational purpose.
8. "Open" computer systems that monitor or automate mechanical or chemical processes and also store information used by computer applications for analysis and decision making.

Q: What is the difference between information technology and computer science?

Chapter 2
Computer Networks

University of Anbar
College of Pharmacy
2020 - 2021

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Computer Networks

In this topic, we are going to discuss in detail about concepts like basics of computer networks, concept of internet, basics of internet architecture, services on internet, World Wide Web and websites, communication on internet, internet services, preparing computer for internet access, web browsing software, search engines, popular search engines/search for content, accessing web browser, using favorites folder, electronic mail.

1. Basics of Computer Networks

Computer network is an interconnection between two or more hosts/computers. The connectivity can be physical by using cables or virtual using wireless network. Different types of networks include LAN, WAN, MAN, etc., as shown below:
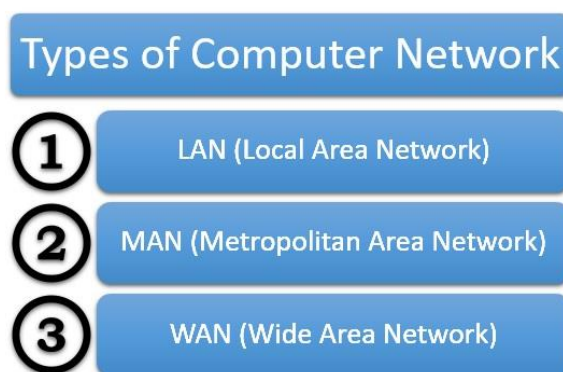
Figure 25: Types of networks

1.1   Local Area Network (LAN)

Local Area Network (LAN) provides data communication within shorter distance and connects several devices such as computers and printers. This type of network contains computers that are relatively closer and are physically connected with cables and wireless media. Any network that exists within a single building, or even a group of adjacent buildings, is considered as LAN. It is often used to connect separate LANs together so they can communicate and exchange data.
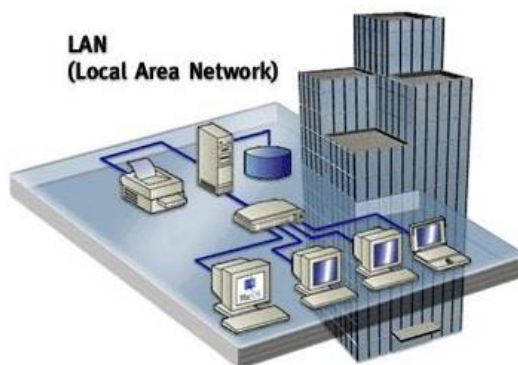
Figure 26: Local Area Network

1.2   Wide Area Network (WAN)

Wide Area Network is connecting two or more LANs together, generally across a wide geographical area.

Example

A company may have its corporate headquarters and manufacturing plant located in one city and marketing office in another city. Each site needs resources, data and programs locally, but it also needs to share data with other sites. To accomplish this, the company can attach devices that connect over public utilities to create a WAN.
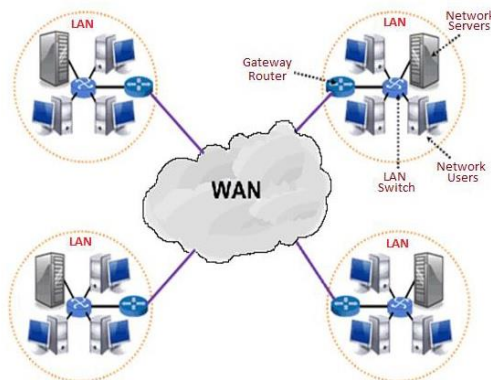
Figure 27: Wide Area Network

1.3   Metropolitan Area Network (MAN)

Metropolitan Area Network (MAN) is an extensive network that connects numerous corporate LANs together. Usually MANs are not owned by sole organization. Their communication devices and equipment are maintained by a group or single network provider that sells its networking services to corporate customers. MANs often take the role of high-speed network that allows sharing of regional resources. MANs also can provide a mutual connection to other networks using a WAN link.
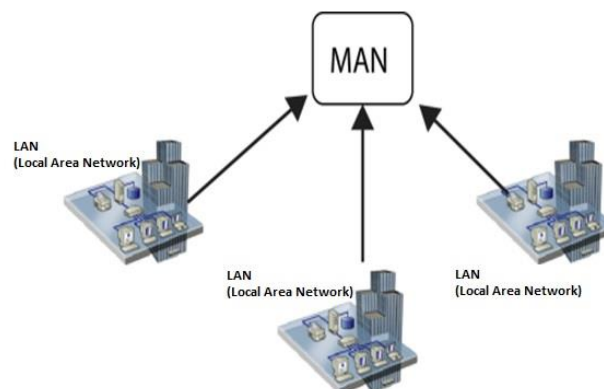
Figure 28: Metropolitan Area Network

2. Internet

Internet is a global communication system that links together thousands of individual networks. It allows exchange of information between two or more computers on a network. Thus, internet helps in transfer of messages through mail, chat, video and audio conference, etc. It has become mandatory for day-to-day activities: bills payment, online shopping and surfing, tutoring, working, communicating with peers, etc.

2.1   Internet Architecture

Internet architecture is a meta-network, which refers to a congregation of thousands of distinct networks interacting with a common protocol. In simple terms, it is referred as an internetwork that is connected using protocols. Protocol used is TCP/IP. This protocol connects any two networks that differ in hardware, software and design. TCP/IP provides end to end transmission, i.e., each and every node on one network has the ability to communicate with any other node on the network.

2.2   Communication on Internet

We shall discuss how communication happens through the use of Internet in this section −

1. **Email**

    Electronic mail or email is one of the key parts of e-revolution which is specially designed for communication purpose. Once you have an email account, you can start sending electronic messages to anyone if you have the recipient's email address. The format of an email address is "**username**, @ symbol, **domain name (yahoo.com, gmail.com, etc.)**". For example: **name@yahoo.com**.

2. **Internet Relay Chat (IRC)**

    IRC is a form of real-time internet chat or synchronous conferencing. It is mainly used for group communication in discussion forums called channels, also allows one-to-one communication via private message, and both chats and data transfers via Direct Client-to-Client protocol.

3. **Video Conference**

    A video conference is a telecommunication technology, which permits two or more people in different locations to interact via mutual video or audio transmission simultaneously. It is also called visual collaboration and is a type of groupware. Video conferencing uses telecommunication technology to bring people at different sites together for a meeting/conversation. This can be as simple as a conversation between two people in private offices, or involves several sites with more than two people. It can also be used to share documents, computer displayed information, whiteboards, etc.

4. Voice Over Telephony (VOIP)

VOIP stands for voice over IP, where IP refers to the Internet Protocol which is a base for all internet communications. This phenomenon began as an optional mutual voice extension to some of the instant messaging systems that took off around the year 2000. In recent years, VOIP systems are easy to use and as convenient as a traditional telephone. Voice quality can still differ from call to call but is often equal to and can even beat the traditional calls.

Figure 29: Voice Over Telephony

5. Instant Messaging

Instant Messaging (IM) is a process of transferring real-time messages between users. It facilitates private chat room atmosphere. IM alerts users when some of their peers are online, so the users can start chatting with them.

6. Remote access

Internet permits computer users to connect to other computers across the world and to store information effortlessly. This can be done with or without any security, authentication and encryption technologies depending on the requirements which encourages work from home culture.

7. File Sharing

A file or document can be e-mailed to anyone as an attachment. It can be uploaded to a website or FTP server, for users to download content easily. It can be put into a shared location or onto a cloud for instant use by colleagues.

8. Streaming media

Many existing radio and television presenters provide internet "feeds" of their live audio and video streams. An internet-connected device, such as a computer or something more specific, can be used to access on-line media in much the same way, as television or radio receiver.

3. Web Browsing Software

"World Wide Web" or simple "Web" is the name given to all the resources of internet. The special software or application program with which you can access web is called "Web Browser".

- ### Launching a Web Browser

Web browser is an application that is located on a computer's disk. Once you have an internet connection, you can launch a web browser using the following methods −

Method 1

Step 1 − Go to "Start Menu".
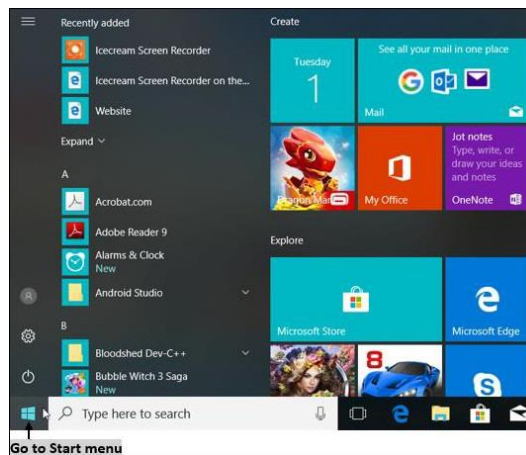
Step 2 − From the menu opened, click on the web browser (Mozilla, Google Chrome, Internet Explorer).

Method 2 − Alternate way is to click the shortcut icon on the taskbar or desktop.

- ## Popular Web Browsing Software

The most popular web browsing software includes:

1. **Google Chrome**

    Google Chrome is a web browsing software developed in the year 2008 by Google Inc. First, it was designed for windows platform, and later adopted to Linux, Macintosh, and even Android. It is written using C++, Assembly, Python, and JavaScript.

2. **Mozilla Firefox**

    Mozilla Firefox is a web browsing software developed in the year 2002 by the Mozilla Foundation. It is designed to work on all operating systems like Windows, Macintosh, Linux, and Android. It is written using C++, JavaScript, Rust, C, CSS, XUL, and XBL.

3. **Opera**

    Opera is a web browsing software developed in the year 1995 by Opera Software. It is designed to work on all operating systems like Windows, Macintosh, and Linux and is written using C++ language.

4. **Internet Explorer**

    Internet Explorer is a web browsing software developed in the year 1995 by Microsoft. It is designed to work on all operating systems like Windows, Macintosh, Linux and Android and is written using C++ language.

- ## Search Engines

Search Engine is an application that allows you to search for content on the web. It displays multiple web pages based on the content or a word you have typed.

The most popular search engines are listed below.

1. **Google**

    Google is the most popular and robust search engine launched in the year 1997 by Google Inc. It was developed by Larry Page and Sergey Brin. It is written using C, C++ and Python. Beyond searching content, it also provides weather forecasts, sports score, temperatures, area codes, language translation, synonyms, etc. Now-a-days the advancement is still more, that it displays maps in a touch.
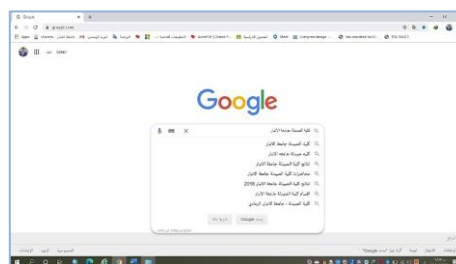
2. Bing

Bing is also a popular search engine launched by Microsoft in the year 2009. It is written using ASP .Net language. It is used to search web content, video, images, maps, etc.
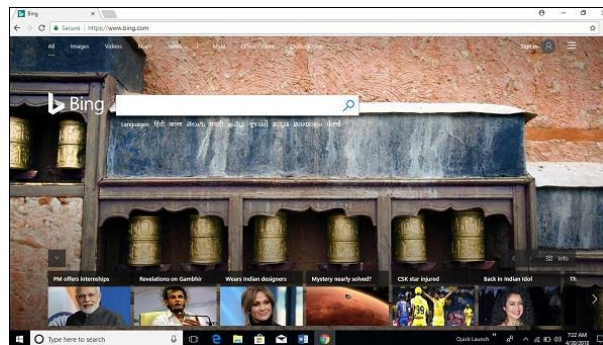
3. Yahoo

Yahoo is a common search engine launched by Yahoo in the year 1995. It is a multilingual search engine and written using PHP language.
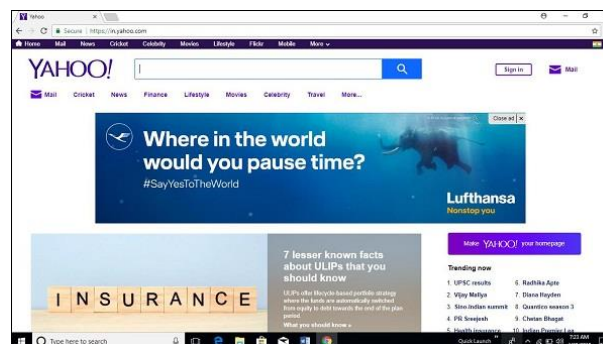
4. Ask

Ask is the most popular search engine and application for e-business which was launched by IAO in the year 1996. It was developed by Garrett Gruener, David Warthen, and Douglas Leeds.
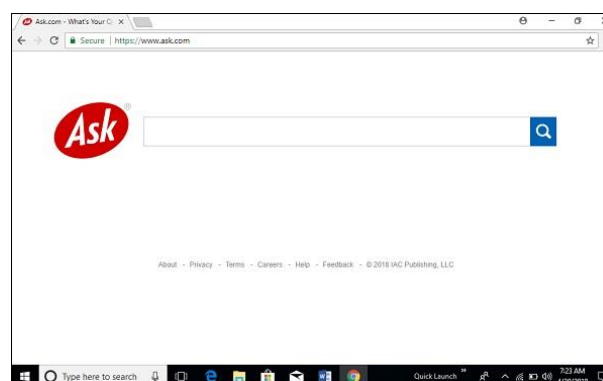
- **Search for The Content**

Search Engine helps to search for content on web using the following steps.

Step 1 − Launch your web browser.

Step 2 − In "Address bar/Location", type the search engine you want to use and press enter.
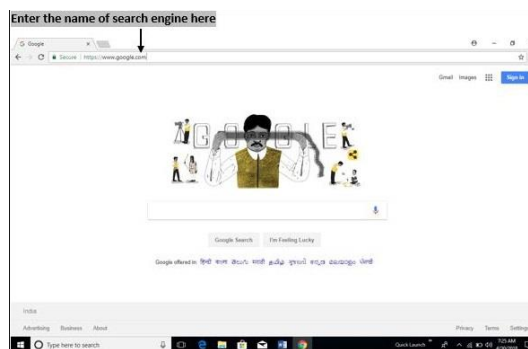
Step 3 − Type the content you want to search in the "search text box" and press enter.
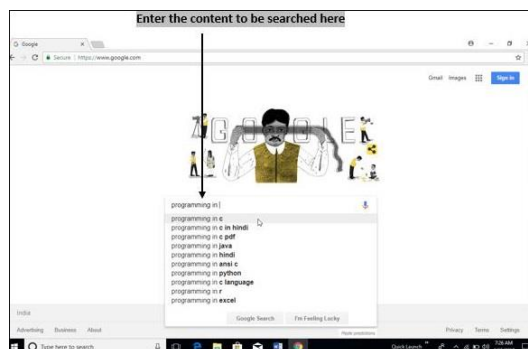
Step 4 − It displays a list of web pages from which you can select corresponding content/web page you want.
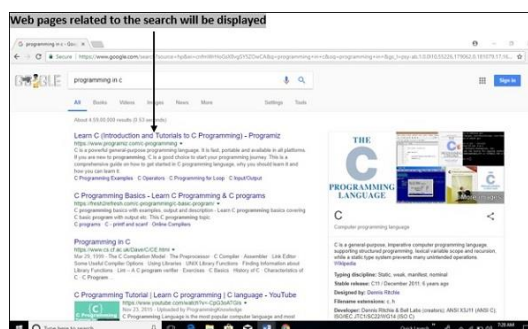
4. Mail

Electronic mail (email or e-mail) is a method of exchanging messages ("mail") between people using electronic devices. More plainly, e-mail is a message that may contain text, files, images, or other attachments sent through a network to a specified individual or group of individuals.

Email operates across computer networks, primarily the Internet. Today's email systems are based on a store-and-forward model. Email servers accept, forward, deliver, and store messages. Neither the users nor their computers are required to be online simultaneously.

- **Gmail**

Gmail is a free email service developed by Google. Users can access Gmail on the web and using third-party programs that synchronize email content through POP or IMAP protocols. Gmail started as a limited beta release on April 1, 2004 and ended its testing phase on July 7, 2009.

At launch, Gmail had an initial storage capacity offer of one gigabyte per user, a significantly higher amount than competitors offered at the time. Today, the service comes with 15 gigabytes of storage. Users can receive emails up to 50 megabytes in size, including attachments, while they can send emails up to 25 megabytes. In order to send larger files, users can insert files from Google Drive into the message. Gmail has a search-oriented interface and a "conversation view" similar to an Internet forum. By 2018, Gmail had 1.5 billion active users worldwide.
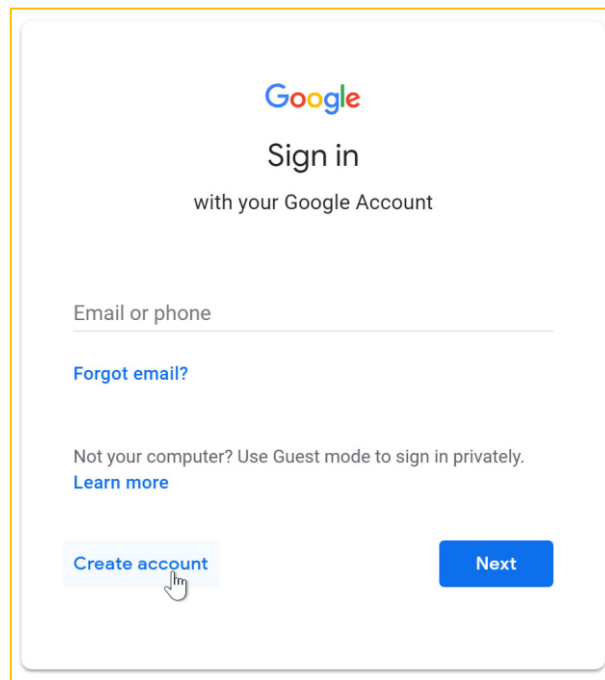
A. Setting up a Gmail account

To create a Gmail address, you'll first need to create a Google account. Gmail will redirect you to the Google account sign-up page. You'll need to provide some basic information like your name, birth date, gender, and location. You will also need to choose a name for your new Gmail address. Once you create an account, you'll be able to start adding contacts and adjusting your mail settings.

- **Create an account**
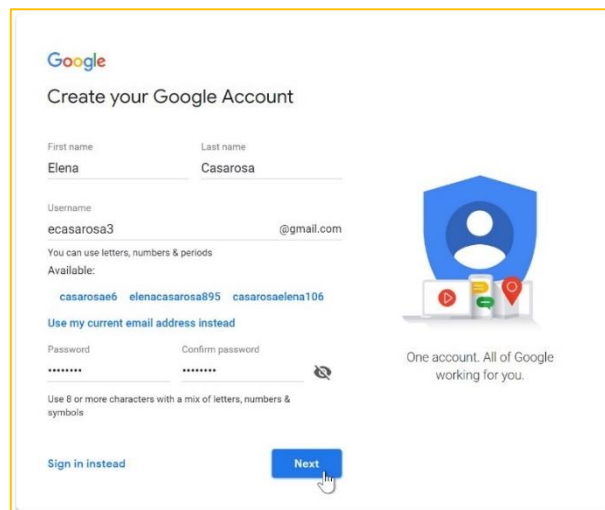
    To create an account:
1. Go to **www.gmail.com**.
2. Click **Create account.**
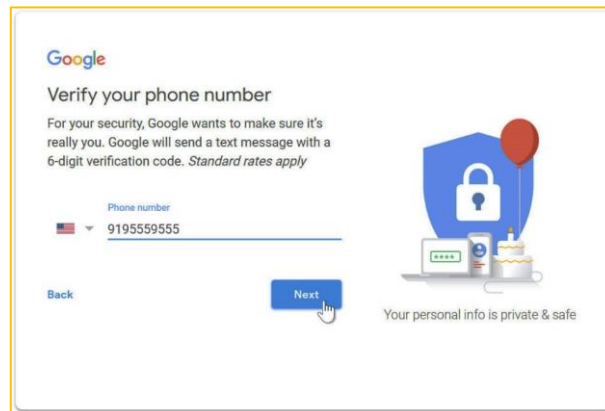
3. The **sign-up** form will appear. Follow the directions by entering the required information.

4. Next, enter your **phone number** to verify your account. Google uses a two-step verification process for your security.
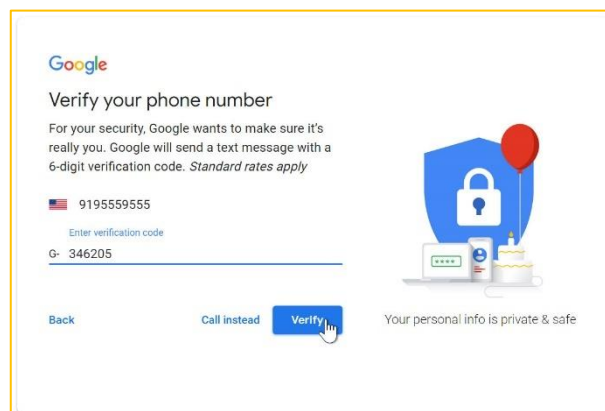
5. You will receive a text message from Google with a **verification code**. **Enter the code** to complete the account verification.

6. Next, you will see a form to enter some of your personal information, like your name and birthday.

7. Review **<u>Google's Terms of Service</u>** and **<u>Privacy Policy</u>**, then click **I agree**.
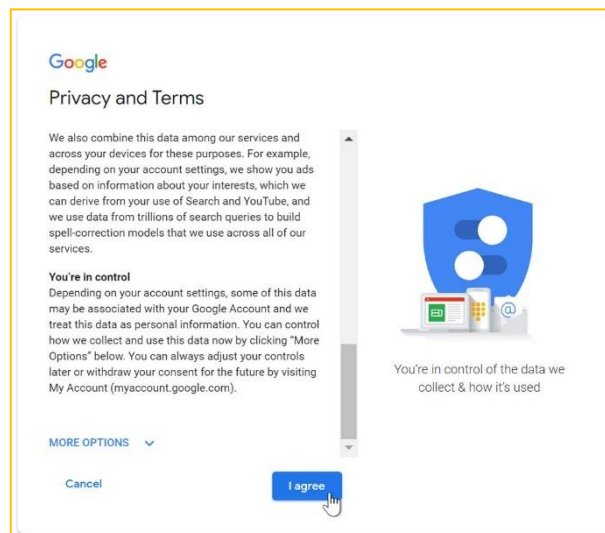
8. Your account will be created.
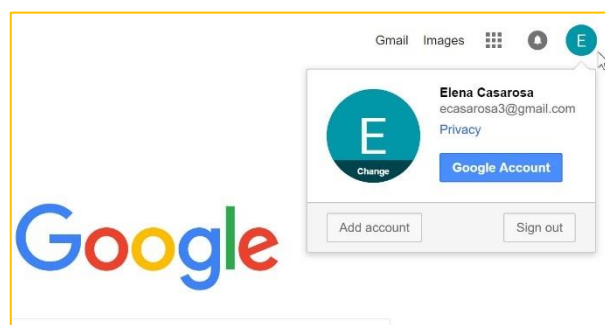
Just like with any online service, it's important to choose a **strong password**—in other words, one that is difficult for someone else to guess. For more information, review our lesson on **creating strong passwords**.

B. Signing in to your account

When you first create your account, you will be automatically signed in. Most of the time, however, you'll need to **sign in** to your account and **sign out** when you're done with it. Signing out is especially important if you're using a shared computer (for example, at a **library** or **office**) because it prevents others from viewing your emails.

To sign in:

1. Go to **www.gmail.com**.
2. Type your **user name** (your email address) and **password**, then click **Next**.
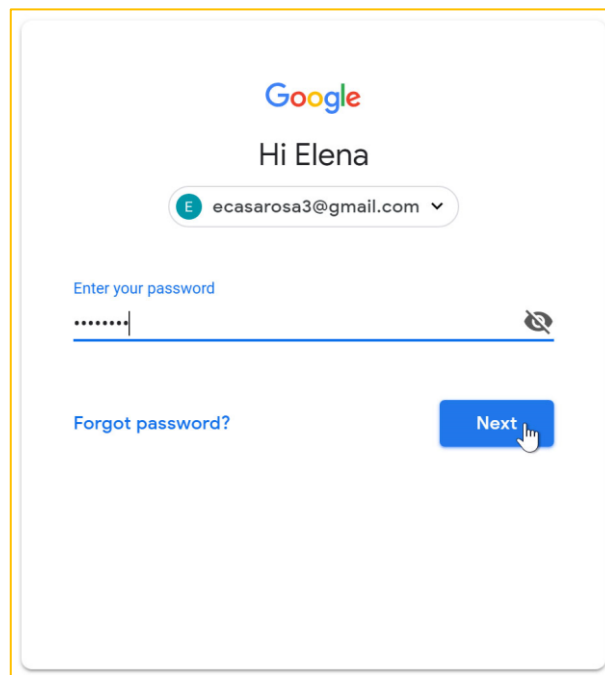
To sign out:

In the top-right corner of the page, locate the circle that has your first initial (if you've already selected an avatar image, it will show the image instead). To sign out, click the circle and select **Sign out**.
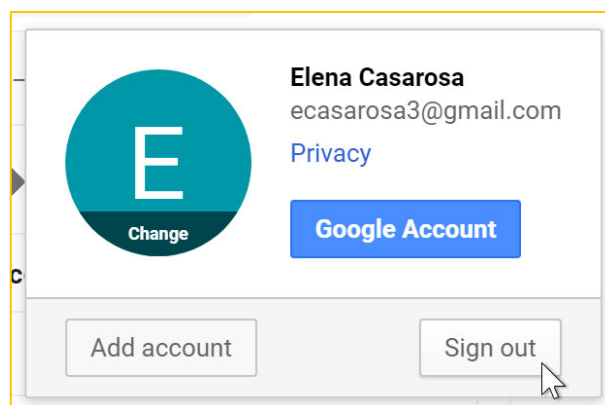
C. Sending email

When you write an email, you'll be using the **compose window**. This is where you'll add the **email address of the recipient(s)**, the **subject**, and the **body** of the email, which is the message itself. You'll also be able to add various types of **text formatting**, as well as one or more **attachments**. If you want, you can even create a **signature** that will be added to the end of every email you send.

The compose window

Click the buttons in the interactive below to learn about the different parts of the compose window.
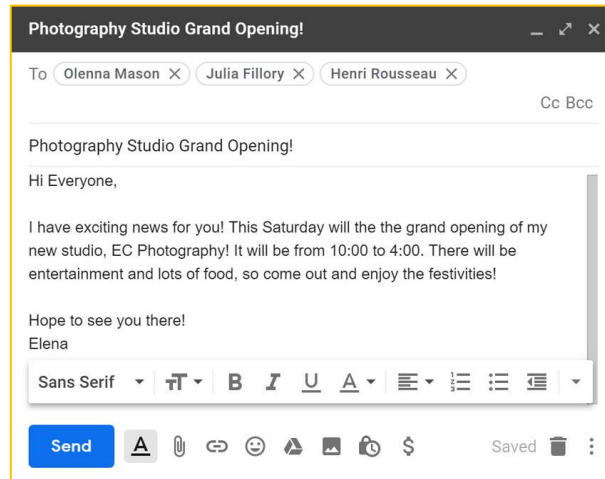
To send an email:

1. In the **left menu pane**, click the **Compose** button.
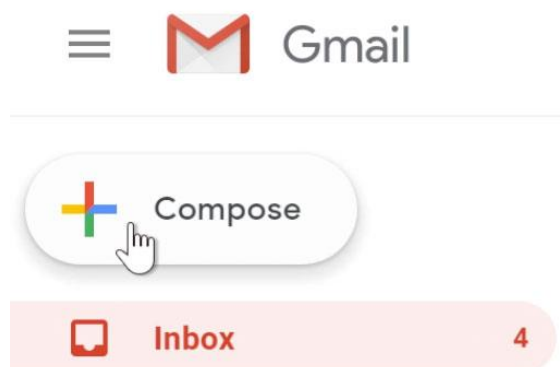
2. The **compose window** will appear in the lower-right corner of the page.
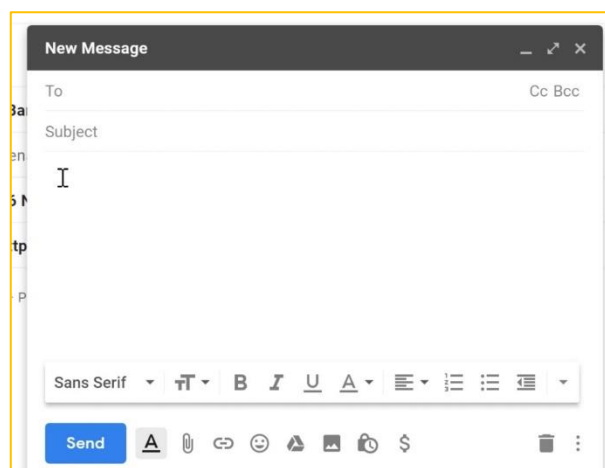
3. You'll need to add one or more **recipients** to the **To: field**. You can do this by typing one or more **email addresses**, separated by commas, or you can click **To** to select recipients from your **contacts**, then click **select**.
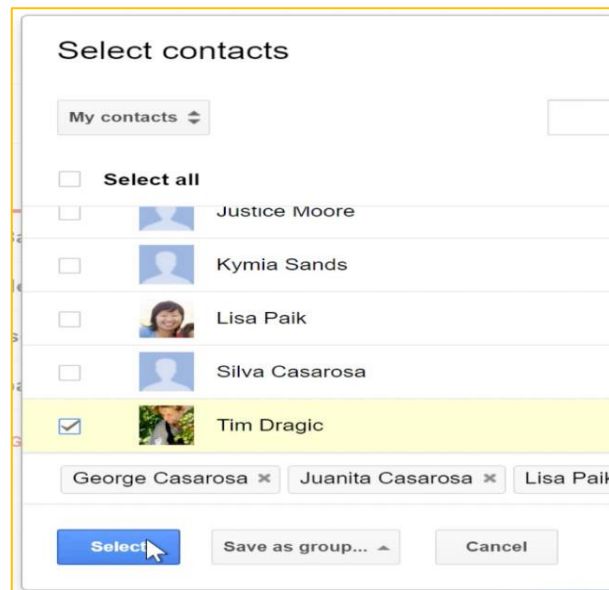
4. Type a **subject** for the message.

5. In the **body** field, type your message. When you're done, click **Send**.
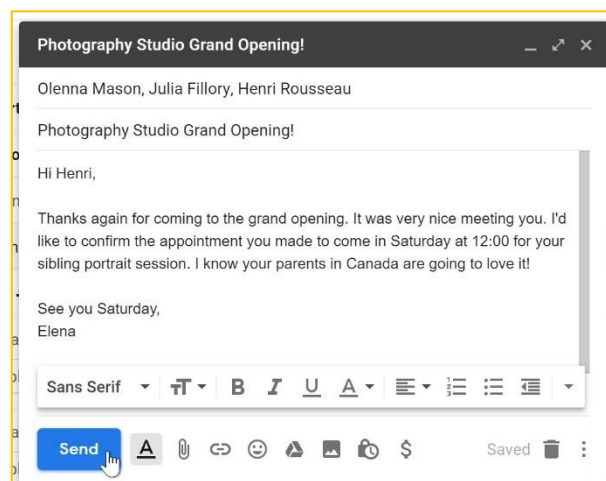
If the person you are emailing is already one of your contacts, you can start typing that person's **first name**, **last name**, or **email address**, and Gmail will display the contact below the **To: field**. You can then press the **Enter** key to add the person to the **To: field**.
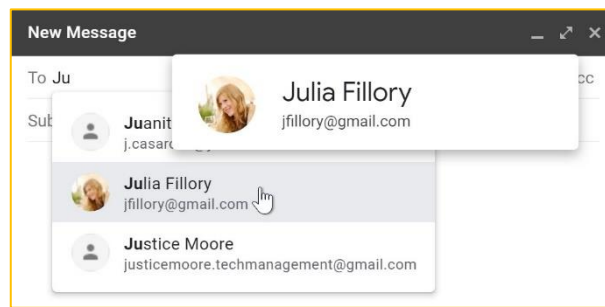
D. Adding attachments

An **attachment** is simply a **file** (like an image or document) that is sent along with your email. For example, if you are applying for a job, you might send your **resume** as an attachment, with the body of the email being the **cover letter**. It's a good idea to include a **message** in the body of your email explaining what the attachment is, especially if the recipient isn't expecting an attachment.

Remember to attach your file **before** you click **Send**. Forgetting to attach a file is a surprisingly common mistake.

To add an attachment:

1. While composing an email, click the **paper clip icon** at the bottom of the compose window.
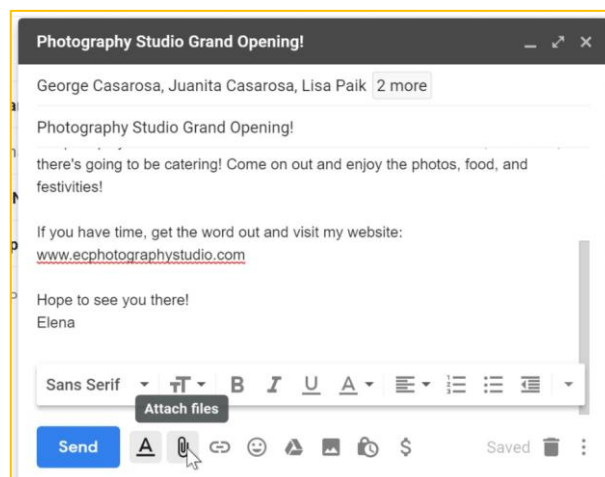
2. A **file upload dialog box** will appear. Choose the file you want to attach, then click **Open**.
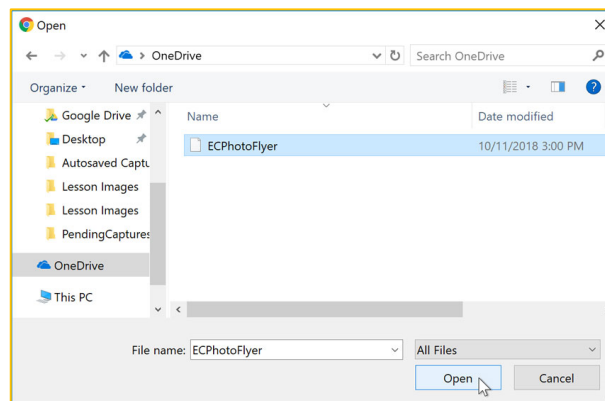
3. The attachment will begin to upload. Most attachments will upload within a few seconds, but larger ones can take longer.
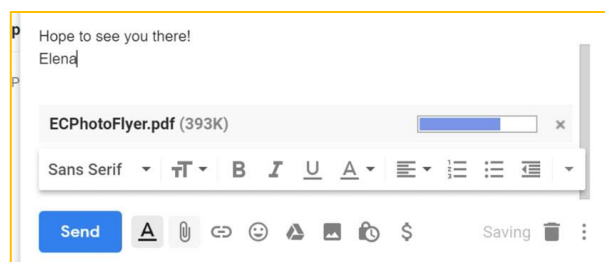
4. When you're ready to send your email, click **Send**.

You can click **Send** before the attachment finishes uploading. It will continue to upload, and Gmail will automatically send the email once it's done.

E. Email formatting

Gmail allows you to add various types of **formatting** to your text.

Click the **formatting button** at the bottom of the compose window to see different formatting options.
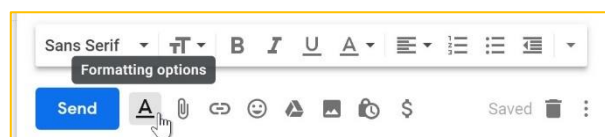
Click the buttons in the interactive below to learn about different formatting options in Gmail.
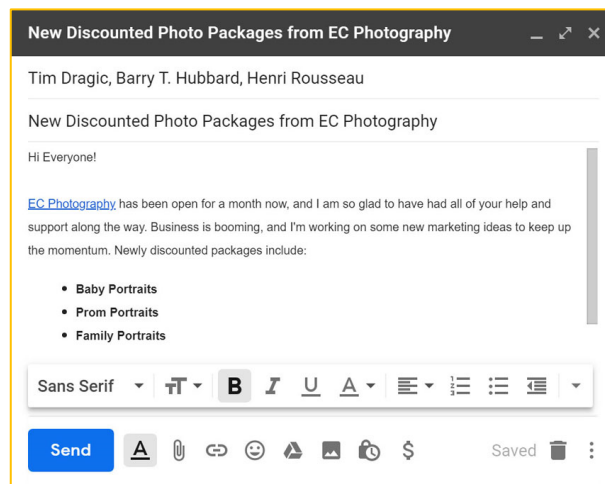
F. Reading email

By default, any email you receive will go to your **inbox**. You'll be able to tell which emails are **unread** because they'll be **bold**. You can also see the name of the **sender**, the **subject** of the email, and the first few words of the **email body**. This means even before you select an email, you can tell quite a few things about it.
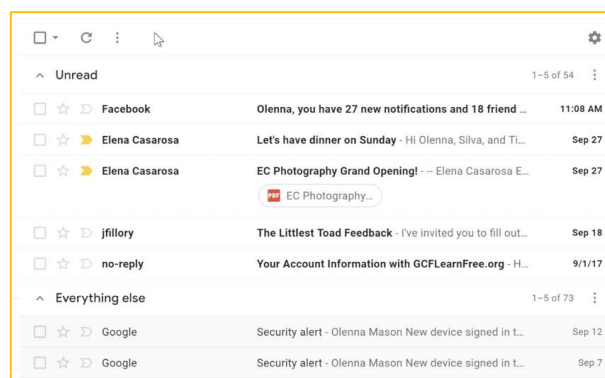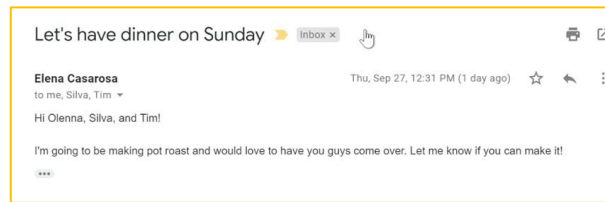

To read an email:

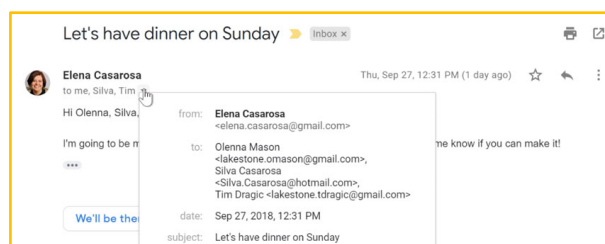1. From your **inbox**, click the email you want to read.
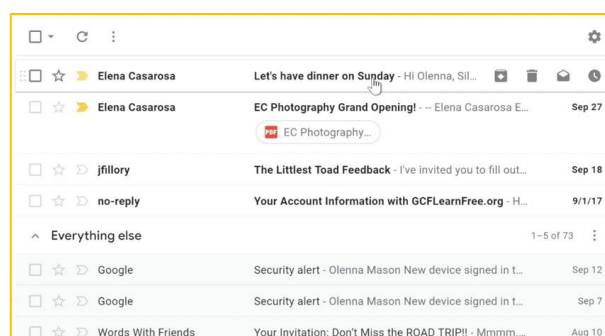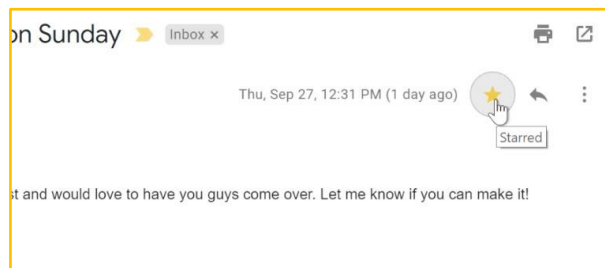

2. The email will open in the same window.

- *Reading options*

In addition to reading the email, you have several reading options.

- You can click **show details** to see the email addresses of the **sender** and any other **recipients**, as well as the **date** the email was sent.
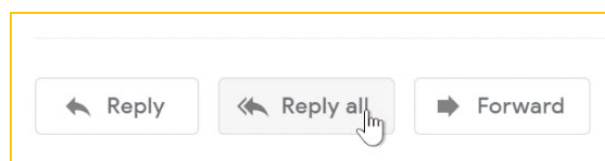

- You can click the **Star** next to the name of the sender to remind yourself to read the email later.
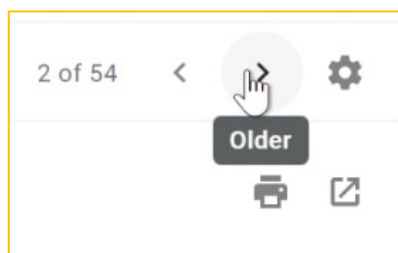

- You can also click the **More** button and select **Add star** from the drop-down menu.
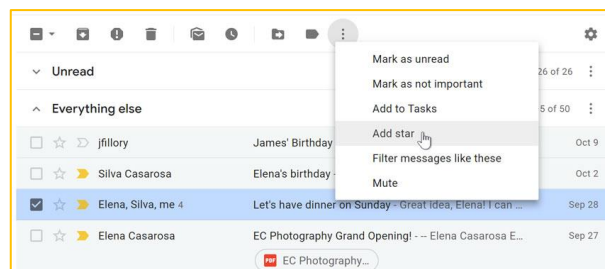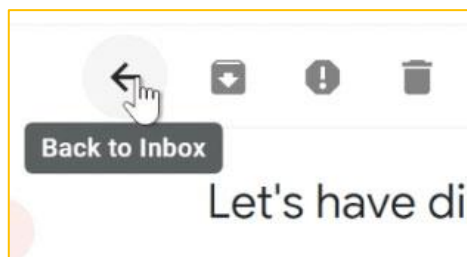

- You can **Reply**, **Reply to all**, or **Forward** the email to someone else.

- You can click **Newer** or **Older** on the right side of the window to view the next email (or previous one).


- You can go **Back to Inbox**.
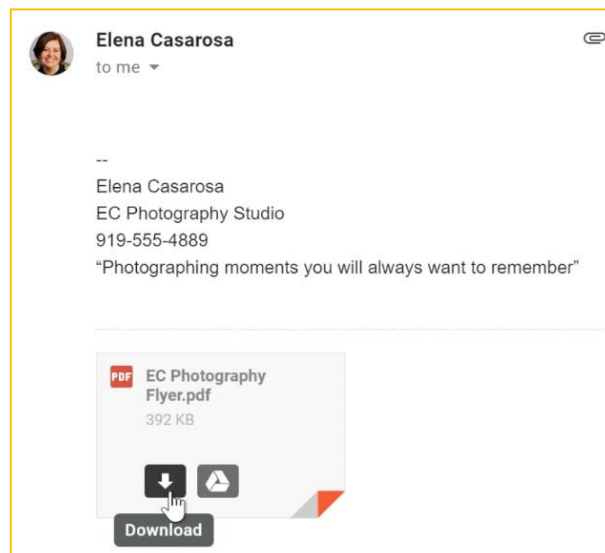

- *Opening attachments*

Sometimes you'll receive emails that contain **attachments**. Generally, you will need to **download** an attachment to view it. However, many common file types, like **Word documents** and **images**, can be viewed within a browser window. If the attachment is an image, you'll also see a smaller copy of the image—called a **thumbnail**—inside the body of the email. You can tell which emails contain attachments because they will have a **paper clip** icon to the right of the **subject**.

To open an attachment:

1. Open the **email message** that contains the attachment.
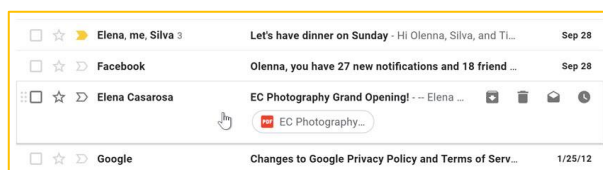
2. Click the **Download icon** to save the attachment to your computer. If your computer asks whether you want to **Open** or **Save** it, choose **Save**. You can then locate the file on your computer and double-click it to open it.

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You should generally only open an attachment if it's from a trusted source. Some attachments can contain **viruses**, especially **.exe** files. If you don't recognize the sender—or if you don't know why someone is sending you the attachment—it's safest not to open it. For more information, read our lesson on **avoiding spam and phishing** from our **Internet Safety** tutorial.

G. Replying to emails

Most of the time, you will be **replying** to an email someone else sends you instead of composing a new message. When you **reply**, the recipient's email address will automatically appear in the **To:** field, so you won't need to worry about choosing the recipient.
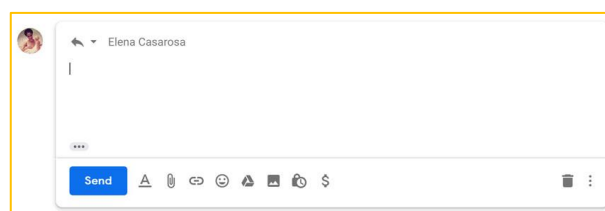

Sometimes you'll receive emails where you're not the only recipient, and you'll need to decide whether you want to **reply just to the person who sent the message** or **reply to all** (the sender and all recipients). For example, if you're collaborating with a group of people via email, you'll probably want to use the **Reply to all** option so everyone gets the message. However, if you want to send a more private message to the sender, you'll need to select the **Reply** option so the message stays between the two of you.
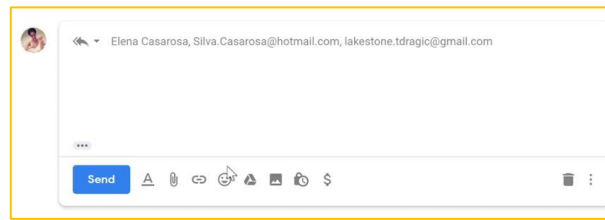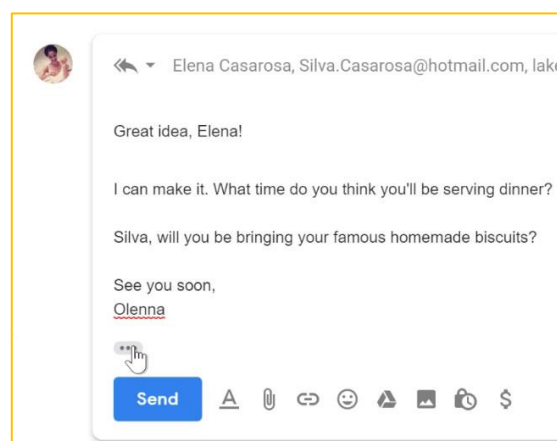
To reply to an email message:

1. While viewing the message, click **Reply** at the bottom of the message. If the message was sent to multiple recipients, you will also have the option to **Reply to all**. You can also click the **Reply arrow** to respond to the message.
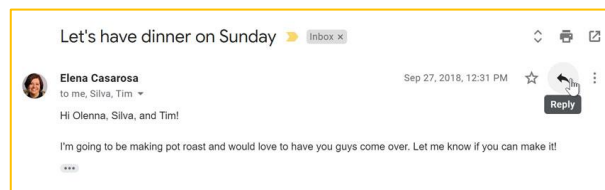
2. You may want to double-check the **To:** and **Cc:** fields to make sure you're sending your message to the correct people. If you are **replying to all recipients**, the additional recipients will appear in the **Cc:** field.

3. Type your message in the **Body** field, then click **Send**.
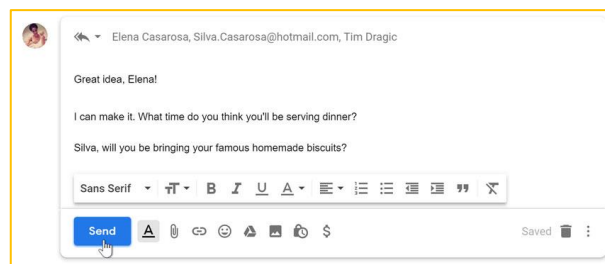
To see the text of the original email while you're replying, click the gray button in the lower-left corner of the window, right above the **Send** button.

H. Forwarding emails

You can also choose to **forward** an email. This basically works the same as **replying**, but it's used to send the email to someone who wasn't one of the original recipients. Just like a reply, the original message will appear as a **quote**. It's usually a good idea to include a brief message of your own to explain why you're forwarding the email.

To forward an email message:

1. While viewing the message, click **Forward** at the bottom of the message. You can also select **Forward** from the More drop-down menu next to the Reply arrow.
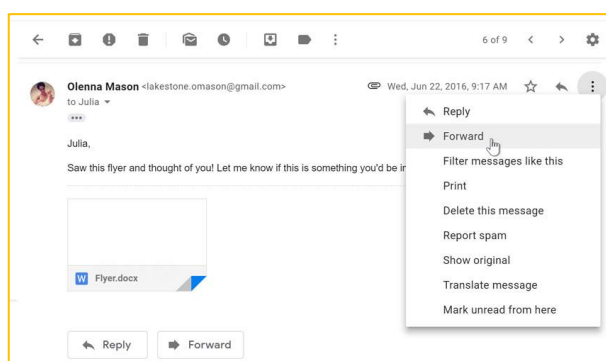
2. Type the recipient's email address in the **To: field**, or click **To** to choose a recipient from your contacts. If the person is in your contacts, you can start typing his or her name and that contact's email address should appear.
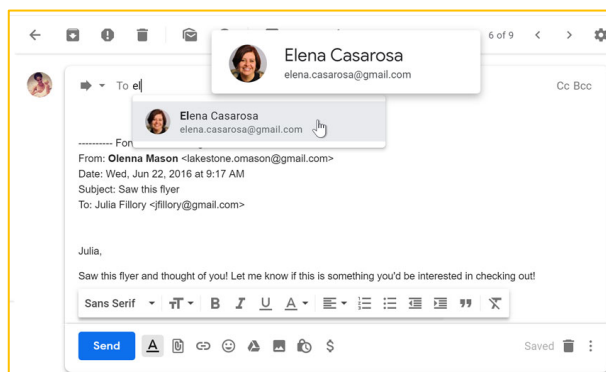
3. Type your message in the **Body** field, then click **Send**.
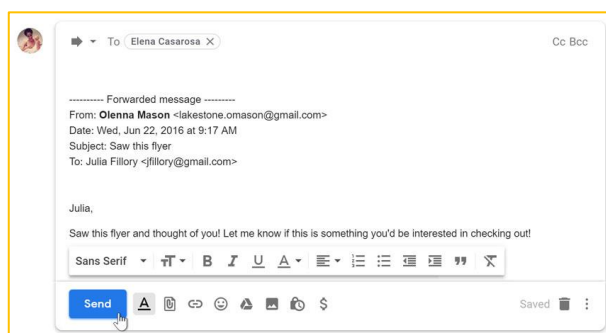
Chapter Three

Computer Viruses and Crimes

1. Computer Viruses

A computer virus is defined as a piece code or program which is executed in a target computer to hamper the smooth functioning of the PC. It replicates itself and can quickly affect hosts of other computers, thus paralyzing the entire network. So, it is important for you to know how to remove it as soon as possible because a malware infection can severely damage your data. It showed its existence in the year 1986 when the first computer virus was created by the name of Brain for MS-DOS operating systems. Mainly a boot sector Virus, it spreads through floppy disks. Nowadays, there are several types of malicious software, which are developed using advanced coding technology.

- **Types of PC Virus**

Although there are thousands of infectious programs that can affect your PC, these are categorized on the basis of their infection targets.

1. **Boot Sector Virus**

Boot Sector Virus infects the Master Boot Record (MBR) of hard disks. Some virus also infects the boot sector of hard drives. It spreads via external sources, for example, an infected floppy disk or USB drive.

2. **Macro Virus**

A macro virus usually targets Microsoft Word, Microsoft Outlook, and similar applications. The piece of the virus is embedded in documents or emails. And you accidentally open the file, the virus gets activated and can spread to other files and folders.

3. **Email Virus**

Email Virus uses email medium to spread and infect PCs. These types of malware come hidden in email attachments and execute as soon as you download or open the attachment.

- **How do Computer Viruses Spread?**

      A computer virus may spread if any external virus infected hard drive is inserted into your PC. These removable devices can be a pen drive, an external hard disk or a floppy drive. Apart from external hard drives, it spreads via email attachments, which can easily carry malware. Your computer can also get infected if you download software, movies, songs, etc. from untrusted websites.

- **Symptoms of Computer Virus Infection**

      You can easily identify the symptoms of computer virus infection. One major indication is that your PC getting extremely slow. Another symptom can be your existing firewall protection getting disabled. You will also experience frequent crashes of applications running on your PC. Other alerts can be hard drive malfunction, error messages & pop-ups.

- **How to Prevent Viruses?**

In order to prevent viruses from infecting your computer, you must follow certain best practices such as:

- Do not insert removable devices/USB devices without scanning using a virus scanner
- Abstain from downloading software from untrusted websites
- Don't open email attachments without verifying the sender id, content, and purpose
- Use a premium antivirus software rather than free software as those may not be capable of providing 100% protection.

- **How to Remove a Virus?**

      In order to eliminate the possibility of infection on your device, you need to first delete all temporary files to speed up the virus scan process. Once you have deleted the temp files, scan your PC using an <u>antivirus software</u>. You can use REVE Antivirus, which scans computer threats using the turbo scan technology. This results in quick virus detection and removal. After the removal of malicious code or infectious files from your computer, always keep your antivirus software updated, so that any kind of latest threat can be detected.

2. Computer Crimes

Cybercrime, or computer-oriented crime, is a crime that involves a computer and a network. The computer may have been used in the commission of a crime, or it may be the target. Cybercrime may threaten a person, company or a nation's security and financial health.

There are many privacy concerns surrounding cybercrime when confidential information is intercepted or disclosed, lawfully or otherwise. Debarati Halder and K. Jaishankar further define cybercrime from the perspective of gender and defined 'cybercrime against women' as "Crimes targeted against women with a motive to intentionally harm the victim psychologically and physically, using modern telecommunication networks such as internet and mobile phones". Internationally, both governmental and non-state actors engage in cybercrimes, including espionage, financial theft, and other cross-border crimes. Cybercrimes crossing international borders and involving the actions of at least one nation-state is sometimes referred to as cyberwarfare.

Classifications of Computer crime

- **Computer crime encompasses a broad range of activities.**
  1. Financial fraud crimes
  2. Cyberterrorism
  3. Cyberextortion
  4. Cybersex trafficking
  5. Cyberwarfare
  6. Computer as a target
  7. Computer as a tool
  8. Obscene or offensive content
  9. Online harassment
  10. Drug trafficking

- **Combating computer crime**
  1. Investigation
  2. Prevention
  3. Legislation
  4. Awareness
  5. Intelligence