# CONTROL AND LEARNING WITH LOGO

## UNIT OUTCOME

**Students will be able to:**

- understand the LOGO language;
- recognize techniques in programming using the LOGO language.

## 6.1 CONTROL AND LEARNING WITH LOGO

In Grade 9, you have learnt about **LOGO** (**L**ogic **O**riented, **G**raphics **O**riented) language. You already know that, LOGO is one of the easiest and simplest computer languages. We can perform various functions using LOGO such as drawing figures, typing text and performing calculations. To perform any action, LOGO uses a triangle shaped turtle that moves on the computer screen. The LOGO turtle can draw and perform actions when you give a command. The LOGO commands are also known as *primitives*.

A LOGO *procedure* is a set of LOGO commands which are given to perform a particular task. In this Unit, you will learn about using variables in writing LOGO procedures and creating recursive procedures in LOGO. The version of LOGO that we are using is *MSW LOGO* (Windows based), which is available from *Softronics, Inc.* as a freeware on the Internet.

### Starting LOGO

To start LOGO, perform the following steps:

Click **Start → All Programs → Microsoft Windows LOGO → Microsoft Windows LOGO**

OR

Double click on the MSW LOGO icon  on the desktop of your computer.

The MSWLOGO Screen will appear. Now, you can use the primitives, perform calculations and write procedures as per your requirement.

### Exiting LOGO

To exit LOGO, type *BYE* in *Command Input Box*.

## ● Using Variables

A *variable* is the name of a memory location that contains a value.

In the RAM (Random Access Memory) of a computer each memory location has an integer address associated with it. The memory locations store data used by programs and these are given symbolic names. Once a variable has a name, we can use and manipulate it.

In LOGO, variables are given names which are strings of letters. For example, NUM, LEN, SIZE, X etc.

**Defining Variables:** The variables in LOGO are defined with the MAKE statement. For example,

MAKE "NUM 50  ; variable NUM is assigned a value of 50

MAKE "LEN 20  ; variable LEN is assigned a value of 20

MAKE "X :X + 1  ; variable X is incremented by 1

### Using Variables in Writing Procedures

In Grade 9, you have written LOGO procedures using:

 1. the *Input Box*.

 2. the *Editor window*.

In LOGO, variables can be "attached" to the procedure names. Variables are used for making a procedure more flexible. You must remember that a **:** (colon) is used before a variable in LOGO procedures. You must not use LOGO keywords as variables. Consider the following examples:

**Example 1** Write a procedure to draw a square which lets the user enter a length for the side.

TO SQUARE :LEN  ; LEN is the length of the side

; Procedure SQUARE has a variable :LEN

 CS      ; Clear Screen
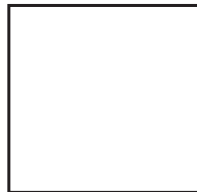
 REPEAT 4 [FD :LEN RT 90]

 HT      ; Hide Turtle

END

Type the following in the *Command Input Box* (there must be atleast one blank space between SQUARE and value of LEN to be given) and press the Enter key to run the procedure:

**SQUARE 50**

This draws a square of side length 50 on the graphics screen as shown below:

What does the LEN value produce?

This draws a square of the side of length inputted by the user.

> In the above example, the **:** (colon) tells LOGO that :LEN is a variable rather than procedure name. We have also used :LEN with FD primitive also, that is, where the variation is required.

**Example 2** Write a procedure to create circles with a variety of radii.

TO CIR :R            ; R is the radius of circle

; Procedure CIR has one variable  :R

    CS                    ; Clear Screen

    CIRCLE  :R

    HT                    ; Hide Turtle

END

Type the following in the *Command Input Box* and press the Enter key to run the procedure:

**CIR 60**

This draws a circle of radius 60 on the graphics screen as shown below:

**Example 3** Write a general procedure for drawing regular polygons having two variables, N the number of sides and LEN the length of its side.

TO POLY :N :LEN        ; N is the number of polygon sides and  LEN is length of the sides

; Procedure POLY has two variables :N and :LEN

    CS                    ; Clear Screen

    REPEAT :N [FD :LEN RT : 360/N]

    HT                    ; Hide Turtle

END

Type the following in the *Command Input Box* and press the Enter key to run the procedure:

**POLY 5 40**

This draws a pentagon of side length 40 on the graphics screen as shown below:
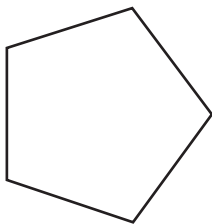
**Example 4**   Write a procedure to create rectangles with varying lengths of side.

TO RECTANGLE :L :B            ; L is the length and  B is the breadth

; Procedure RECTANGLE has two variables  :L and :B

CS                                  ; Clear Screen

REPEAT 2 [FD : L  RT 90 FD :B]

HT                                  ; Hide Turtle

END

Type the following in the *Command Input Box* and press the Enter key to run the procedure:

### RECTANGLE 0    6

This draws a rectangle of length 100 and breadth 50 on the graphics screen as shown below:

## • Using Recursive Procedures

*Recursion* is the process where a procedure calls itself. It is available in nearly all computer languages including LOGO. A *recursive procedure* is a procedure that uses itself as one of its parts.

In LOGO, the easiest way to get a computer to do something over and over (and over and over) is *recursion*. A LOGO procedure is called *recursive* if it calls itself as a sub procedure. In other words, a recursive procedure repeats itself.

If the last statement in a procedure is a call to this procedure itself again, then the computer will never stop running the procedure. There are two ways to stop recursion:

1. Click *HALT* to stop running the program.

2. Use a condition inside the procedure to stop it after a certain number of repetitions. For example, using a counter in the procedure.

### Creating Recursive Procedures

As mentioned earlier, you can create recursive procedures in LOGO. Consider the following examples:

**Example 1**  The following procedure draws a square of side length 100 using an infinite recursion.

TO SQUARE1

; Procedure SQUARE1 uses infinite recursion

FD 100 RT 90

SQUARE1            ; Call to procedure SQUARE1 itself

END

Type the following in the *Command Input Box* and press the Enter key to run the procedure:

### SQUARE1

This draws a square of side length 100 on the graphics screen as shown below:
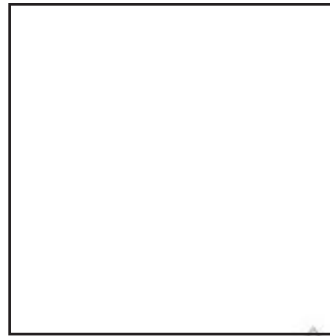


It will run until you click *HALT* to stop it!

In this procedure, the first two lines are drawing a square with side 100. But before the program ends, LOGO meets the word SQUARE1 again. The word 'SQUARE1' starts it all over again, so we get an endless loop with the square of length of side 100 is drawn at the same place again and again.

**Exm ple 2**  The following procedure draws squares of sides of varying length LEN using an infinite recursion.

TO SQUARE2 :LEN

; Procedure SQUARE2 uses infinite recursion

  REPEAT 4[FD :LEN RT 90]

  SQUARE2 :LEN+10     ; Call to procedure SQUARE2 itself

END

Type the following in the *Command Input Box* and press the Enter key to run the procedure:

### SQUARE2 1

This draws squares of varying lengths on the graphics screen as shown below:
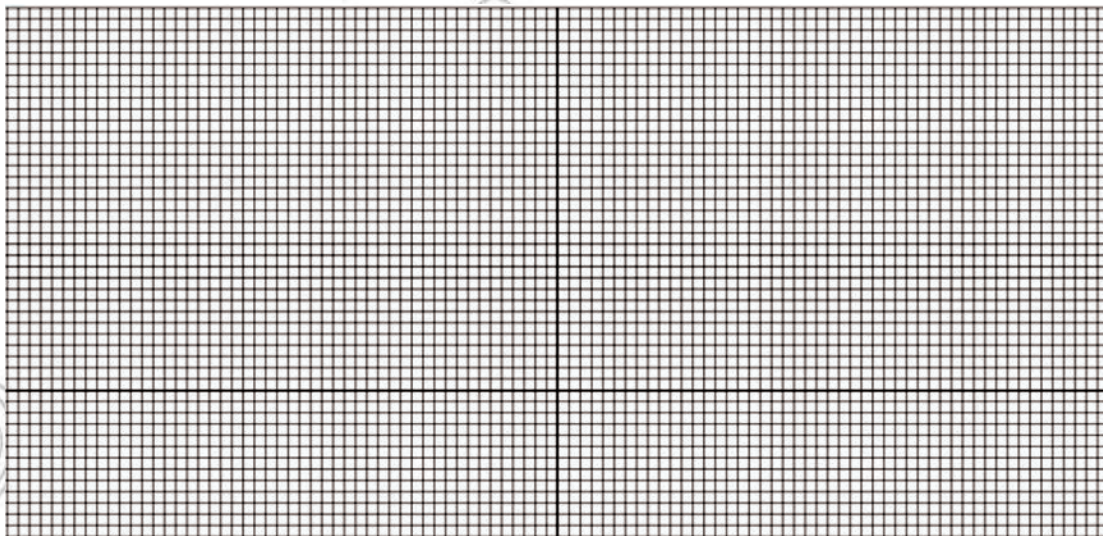


It will run until you click HALT to stop it!

In this procedure, the first two lines are drawing a square with the side you have given.

But before the program ends, LOGO meets the word SQUARE2 again, this time with ten units added to the side. The word 'SQUARE2' starts it all over again, so we get an endless loop with the square getting bigger and bigger.

## Using a Condition to Stop Recursion

We probably would like a procedure to run a fixed number of times rather than going on forever. We can stop a procedure by using a 'conditional' line. For example, edit the procedure SQUARE2 by using in an extra line as follows:
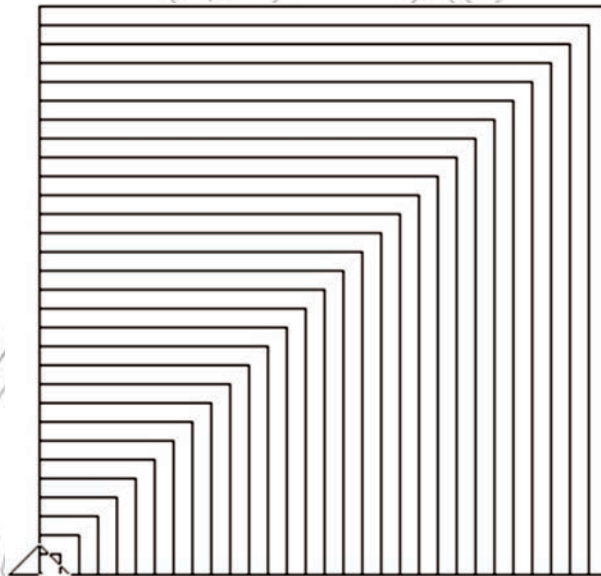
**EDIT S QUARE2**

TO SQUARE2 :LEN
; Procedure SQUARE2 uses recursion and stops conditionally
    REPEAT 4[FD :LEN RT 90]
    IF :LEN > 300 [STOP]
    SQUARE2 :LEN+10   ; Call to procedure SQUARE2 itself
END

Type the following in the *Command Input Box* and press the Enter key to run the procedure:

**SQUARE2 1**

This draws squares of varying lengths as shown below:



What do you observe? LOGO checks how big the length of side LEN is every time the program loops. If the answer is greater than 300, the program is stopped.

**Exam ple 3** The following procedure countdowns from a given number.

TO COUNTDOWN :NUM
; Procedure COUNTDOWN uses recursion
  IF :NUM = 0 [STOP]   ; Condition test
  LABEL :NUM FD 20 RT 5  ; LABEL command prints value of : NUM and moves turtle

COUNTDOWN :NUM–1    ; Procedure call also reduces the value of :NUM by 1

END

Type the following in the *Command Input Box* and press the Enter key to run the procedure:

**COUNTDOWN 0**

This will give the following output:

10 9 8 7 6 5 4 3 2 1
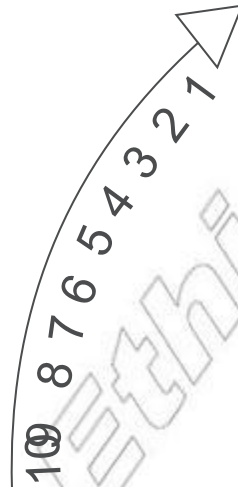
> **note**: The process where a *LOGO* statement calls or runs itself is called *RECURSION*. A recursive procedure is one which 'turns back on itself'.

# Activity 6.1

**PRODUCE A SIMPLE SNOW FLAKE OUTLINE**

Students in groups will produce a simple snow flake outline and present it in the class.

To produce a simple snowflake outline, perform the following steps:

1. Start LOGO and open the *Editor window*.

2. Type the following procedures:

```
        TO TRIANGLE     ; Procedure TRIANGLE to create a triangle
            ST              ; Show Turtle
            REPEAT 3 [FD 20 RT 120]
            HT              ; Hide Turtle
        END

        TO HEX            ; Procedure HEX to create hexagon using the TRIANGLE procedure
            REPEAT 6 [TRIANGLE RT 60]   ; Call to procedure TRIANGLE
        END

        TO SNOWFLAKE   ; Procedure to create snowflake using the HEX procedure
            REPEAT 6 [HEX FD 40 HEX BK 40 RT 60 HEX]   ; Call to procedure HEX
        END
```
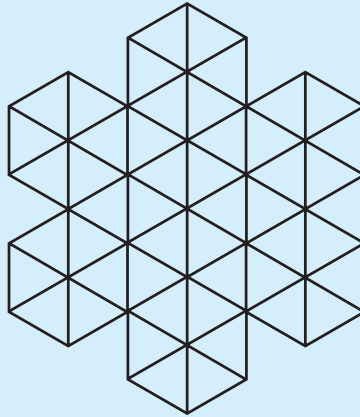
3. To run the procedure SNOWFLAKE, type the following in the *Command Input Box* and press the Enter key:

   SNOWFLAKE

The following output will be displayed on the Graphics screen:



## KEY CONCEPTS

➤ LOGO is one of the simplest and easiest computer languages.

➤ A LOGO procedure is a set of LOGO commands which are given to perform a particular task.

➤ Variables are used for making a procedure more flexible.

➤ Recursion is the process where a procedure repeats itself.

# REVIEW QUESTIONS

## Fill in the Blanks

1. The LOGO commands are also known as ...........................
2. A ........................... is the name of memory location that contains a value.
3. A LOGO procedure is called ........................... if it calls itself as a sub procedure.
4. To exit LOGO, type ........................... in Command Input Box.

## State Whether True or False

1. LOGO is the most difficult computer language.
2. We can use variables in LOGO procedures.
3. Recursive procedures cannot be written in LOGO.
4. We click HALT to stop the running of a LOGO program.

## Multiple Choice Questions

1. MSW LOGO uses simple ........................... commands.
   (*a*) English                        (*b*) Planning
   (*c*) Discussion               (*d*) All of these

2. Which of the following LOGO primitive clears the screen and returns the mouse to its home position?

(*a*) FD            (*b*) LT

(*c*) CS            (*d*) PU

3. In LOGO, when accessing a variable's value you must put a ........................... in front of the variable name.

(*a*) =            (*b*) :

(*c*) ?            (*d*) *

4. All LOGO procedures begin with "To" and end with ........................... .

(*a*) ;            (*b*) Stop

(*c*) Exit            (*d*) End

## Match the Following

| Column A | | Column B |
|---|---|---|
| 1. MSW LOGO | (*a*) | are ignored by MSW LOGO |
| 2. Variables | (*b*) | is the process where a LOGO word calls or runs itself |
| 3. Lines with a semicolon (;) in front | (*c*) | is graphical in nature |
| 4. Recursion | (*d*) | make a LOGO procedure more flexible |

## Answer the Following

1. How will you use variables in writing procedures in LOGO? Explain with suitable examples.
2. Write a LOGO procedure using variable to draw circles.
3. What will the following LOGO procedure do?

```
TO SPIRAL :SIZE :ANGLE
       IF :SIZE > 400 [STOP]
       FD :SIZE RT :ANGLE
       SPIRAL  :SIZE+2 :ANGLE
END
```

4. How will you create a recursive procedure in LOGO? Explain with suitable examples.

## Suggested Activities

1. Create rectangles with varying lengths of sides.
2. Produce a simple snowflake outline.
3. Have full version of the LOGO language.

# GLOSSARY

## A

**Absolute Reference:** Commonly used in spreadsheet applications, it is a formulated cell reference that will not adjust when used to calculate the sum of specific cells.

**Access:** A database program which is a part of the Microsoft Office suite of programs.

**Application Software:** A program that is designed to perform specific tasks.

## B

**Backup:** To copy files or data to a second source or media so as to safeguard it.

**Blog:** (Slang term for a Weblog) A blog is a personal journal that can be accessed publicly and allow people to comment on the previously posted comments.

**Browser:** Software program that allows the user to find and read encoded information in a form suitable for display especially on World Wide Web.

## C

**Cell:** Intersection of a row and column in a worksheet.

**CD-ROM (Compact Disc Read-Only Memory):** A durable and low cost circular optical storage device widely used to store large amounts of information.

**Copyright:** New technologies have raised all kinds of new issues relating to copyright—mainly because it has become so easy to copy materials from a variety of digital sources.

**CPU (Central Processing Unit):** A processor on an IC chip (called a microprocessor) that serves as the 'brain' of the computer.

## D

**Database:** A structured collection of data that can be used for a variety of purposes.

**Data Communications:** The moving or sharing of encoded information between two or more data sources using an electronic medium.

**DBMS (Database Management System):** Application software which enables the storage, modification, retrieval, and querying of data in a database.

**Distribution List:** Also called a mailing list, is a collection of e-mail addresses that allows you to e-mail multiple people at one time.

**Domain Name System:** An addressing system in which abbreviations are used to indicate the type of organization or entity instead of whole name, for example, .edu for educational institution.

**DVD:** Digital Versatile Disc or Digital Video Disc.

## E

**E-Commerce:** Buying and selling or business transaction conducted on the Internet.

**E-Mail:** Stands for Electronic Mail. This is a system of relaying messages across the Internet, from one Internet user to another.

**EPROM** Erasable Programmable Read-Only Memory ("ee-prom"). It is a memory chip whose contents can be erased by a mechanism using ultraviolet light and reprogrammed for other purposes.

## F

**Forms:** Used to provide an easy to use interface for user to enter, view and modify data in a table.

**Format Painter:** Helps to copy the format that has been applied to text and apply it to another.

**Freeware:** This is a shortened version of Free Software. Programmers offer their work without wanting pay in return.

**FTP (File Transfer Protocol):** A software protocol for exchanging information between computers over a network.

## G

**Gigabyte (GB):** 2 to the 30th power (1,073,741,824) bytes. One gigabyte is equal to 1,024 megabytes.

**GIGO:** It is an acronym that stands for Garbage In, Garbage Out.

**Google:** A popular search engine.

**GUI (Graphical User Interface):** A program interface that takes advantage of the computer's graphics capabilities to make the program easier to use. Well-designed graphical user interfaces can free the user from learning complex command languages.

## H

**Hacker:** A person who spends his/her time trying to gain access to information stored on other people's computers all around the world.

**Hardware:** The physical equipment used in a computer system, such as the CPU, peripheral devices and memory.

**Home Page:** The initial page of a site on the World Wide Web.

**HTML (Hypertext Markup Language):** It is a collection of structuring and formatting tags used to create Web pages.

**HTTP (Hypertext Transport Protocol):** The standard protocol for transferring hypertext documents on the World Wide Web.

**Hyperlinks:** A word or graphic display on one web page that allows a computer to shift to another related web page.

**Hypertext:** A method of storing data through a computer program that allows a user to create and link fields of information at will and to retrieve the data non-sequentially.

## I

**Icon:** A picture or symbol to represent a command on a computer screen.

**IDE (Integrated Development Environment):** A programming environment integrated into an application.

**Internet Explorer:** A browser produced by the Microsoft Corporation and supplied together with the Windows operating system.

**IT (Information Technology):** The development, implementation, and maintenance of computer hardware and software systems to organize and communicate information electronically.

**Integrated Circuit (IC):** A circuit of transistors, resistors, and capacitors constructed on a single semiconductor wafer or chip, in which the components are interconnected to perform a given function.

**Internet:** The Internet is a network of networks all of which use the same set of communications protocols.

**Intranet:** A private network for communications and sharing of information that, like the Internet, is based on TCP/IP but is accessible only to authorized users within an organization. An organization's intranet is usually protected from external access by a firewall.

**ISP (Internet Service Provider):** A company that provides access to the Internet.

## J

**JAVA:** A high-level programming language developed by Sun Microsystems.

**Joystick:** A device that looks a bit like a gear lever in a car. This is connected to a computer and is used mainly for controlling the cursor in fast action games.

## K

**Kilobyte (KB):** This is about a thousand bytes of space. In reality, it is two to the 10th power or 1,024 bytes.

## L

**LAN (Local Area Network):** A network that links together computers and peripheral equipment within a limited area, such as a building or a group of buildings.

**Language Processor:** Software that converts a high level language or assembly language code into machine understandable form.

**Login:** To attach to a computer using the user's ID.

**LOGO (Logic Oriented, Graphics Oriented):** A high level programming language specifically designed for its ease of use and graphics capabilities.

## M

**Megabyte (MB):** About a million bytes of space. Actually it is 2 raised to the 20th power or 1,048,576 bytes of space.

**Memory:** Internal storage areas in the computer.

**MODEM** Stands for MOdulator and DEModulator. It is a device that changes data from digital (computer language) to analog (phone line language) and then back again.

**Motherboard:** The main circuit board of a microcomputer.

**MS-Access:** Database application software, provided by Microsoft.

**MS-Excel:** Spreadsheet application software, provided by Microsoft.

**MS-PowerPoint:** Presentation software, provided by Microsoft.

**MS-Word:** Word processing application software, provided by Microsoft.

# N

**Navigation:** It is the process of finding the way, *i.e.*, navigating, around a series of menus within a computer program or finding the way around the World Wide Web by means of a browser.

**Netiquette:** The rules of etiquette that apply when communicating over computer networks, especially the Internet.

# O

**Offline:** Not connected to a computer or network of computers.

**Online:** Connected to a computer or network of computers, especially the World Wide Web.

**Outlook:** A popular e-mail program, part of the Microsoft Office suite of programs.

**Output:** Anything that comes out of a computer after being processed.

**Output Device:** A device that translates information processed by the computer into a form that humans can understand.

# P

**PDF (Portable Document Format):** A technology developed by Adobe and was designed to capture all of the elements of a printed document and place it in a single image file.

**Pen Drive:** A secondary storage device that can be used to easily transfer files between USB-compatible systems.

**Portal:** A Webpage, website or service that acts as link or entrance to other websites on the Internet.

**Printout:** Anything produced on a printer after being processed by a computer program.

**Primary Key:** A set of one or more values in a database that uniquely identifies a record in a table.

**Primitives:** The LOGO commands are known as 'Primitives'.

**Procedure:** The sequence of actions or instructions to be followed in solving a problem or accomplishing a task. It may be used at one or more points in a computer program.

**Programmable Read-Only Memory (PROM:** A special memory chip that is blank when first purchased. It can be written by the user by using a special hardware program. Once the data is written to it, it cannot be erased or changed.

**Protocol:** A set of rules governing the format of messages that are exchanged between computers.

# Q

**Query:** Used to retrieve information on a certain condition from a database.

# R

**RAM (Random Access Memory):** A volatile computer memory available to the user for the temporary storage and manipulation of data.

**Relative Reference:** The default reference in a spreadsheet package.

**Reports:** Used to present data in a printed format.

**ROM (Read-Only Memory):** A memory in which program instructions, operating procedures, or other data are permanently stored, generally on electronic chips during manufacture, and that ordinarily cannot be changed by the user or when power is switched off.

# S

**Scroll Bar:** A widget found in graphical user interface and used to show and control which portion of a document is currently visible in a window. A window may have a horizontal or, vertical scroll bar, or both.

**Scanner:** A device used to convert hard copy, *e.g.*, a printed page, photograph or photographic negative, into a form that can be stored on a computer.

**Server:** This is a mainframe computer that serves the other computers attached to it.

**Sheet Tab:** In spreadsheet applications, this refers to a tab at the bottom of a worksheet that acts as a means to identify or access different sheets within a workbook.

**Slide Show:** Used to display the slides in a desired sequence.

**Source Code:** Program code written in a high level language.

**Social Networking:** A term applied to a type of website where people can seek other people who share their interests, find out what's going on in their areas of interest, and share information with others.

**Source data:** Data for which the chart is prepared.

**Software:** The set of instructions used to direct the operation of a computer, as well a documentation giving instructions on how to use them.

**Spreadsheet:** A document which helps to organize data in rows and columns that intersect to form cells.

**System:** A combination of the hardware, software, and firmware. A system typically consists of components (or elements) which are connected together in order to accomplish a specific function or set of functions.

**System Software:** It is a set of master programs that keeps the computer system working.

## T

**Task bar:** The bar that contains the start button and appears by default at the bottom of the desktop.

**TCP/IP:** Acronym for Transmission Control Protocol/Internet Protocol, the suite of communications protocols used to connect hosts on the Internet.

**Terabyte (TB):** 2 to the 40th power (1,099,511,627,776) bytes.

**Trojan:** A type of computer virus that is loaded into an unsuspecting users system via a host program such as a free game.

**Turtle:** A triangular shape pointer used in LOGO that helps in drawing figures.

**Twitter:** A microblogging facility that allows users to post very short texts (maximum 140 characters) containing snippets of information about what they are doing at a given moment, news items, links to websites or comments on events.

## U

**Uploading:** It means transmitting data from a local computer to a remote computer, as from your PC to a website you are constructing.

**UPS (Uninterruptible Power Supply):** It is a backup power unit that provides continuous power when the normal power supply is interrupted.

**URL (Uniform Resource Locator):** A protocol for specifying addresses on the Internet. It is an address that identifies a particular file on the Internet, usually consisting of the protocol as http, followed by the domain name.

## V

**Videoconferencing or Video Conferencing:** A computer-based communications system that allows a group of computer users at different locations to conduct a "virtual conference" in which the participants can see and hear one another as if they were in the same room participating in a real conference.

**Virus:** A program or piece of code that is loaded onto your computer without your knowledge and runs against your wishes.

## W

**W3C (World Wide Web Consortium):** An international non-profit organization which acts as a resource centre for the World Wide Web, and is active in setting technical standards.

**WAN (Wide Area Network):** A network in which computers are connected to each other over a long distance, using telephone lines and satellite communications.

**Webcam:** A camera connected to a computer and linking it to the Internet.

**Web page or Webpage:** A single, usually hypertext document on the World Wide Web that can incorporate text, graphics, sounds, etc.

**Web server:** A computer that runs specific software to serve web pages to the Internet.

**Web site:** A connected group of pages on the World Wide Web regarded as a single entity, usually maintained by one person or organization and developed to a single topic or several closely related topics.

**Wizard:** A utility that provides guided sequence to perform complex task easily and quickly.

**Word Processor:** Software that processes textual matter and creates organized documents.

**Workstation:** The computer attached to the Internet.

**WWW (World Wide Web):** Series of servers or computers that are interconnected through hypertext.

**WYSIWYG:** What You Say Is What You Get.

## X

**XML (eXtensible Markup Language):** It is a markup language, not limited to Web documents.

## Y

**YouTube:** A website to which we can upload our own video clips and view video clips uploaded by others: http://www.youtube.com.

## Z

**Zip Disks:** The disks with a special high-quality magnetic coating that have a capacity of 100, 250 or 750 megabytes.