INFORMATION & COMMUNICATIONS TECHNOLOGY

STANDARD X

PART 2 $\frac{2}{2}$

GOVERNMENT OF KERALA
GENERAL EDUCATION DEPARTMENT

INFORMATION & COMMUNICATIONS TECHNOLOGY

STANDARD

X

Part II

GOVERNMENT OF KERALA

GENERAL EDUCATION DEPARTMENT

STATE COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING (SCERT), KERALAM

2025

PREFACE

Dear students,

The advancements in Information and communications technology have impacted every walk of life. The new age gives us the message that we need to stay updated throughout our lives. This book has been prepared to cover the latest domains in information communications technology, helping us stay in tune with these developments.

The chapters in this book, such as Graphic Designing, Desktop Publishing, Webpage Designing, Python Programming, Robotics, Animation, Database Management, and Cyber Space, are designed to help you think creatively, experience new concepts, and present novel ideas.

This book includes interesting activities involving Stellarium, the desktop planetarium software; GeoGebra, the interactive geometry software; and similar tools. These tools would help you apply your learning to other subjects easily.

It is expected that the ICT tools you are familiar with will enable you to acquire knowledge through innovative methods. It will help you become a creative individual who can use technology in your own life and for the advancement of society.

With regards,

Dr. Jayaprakash R.K
Director
SCERT.

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Each chapters also contains illustrations

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THE CONSTITUTION OF INDIA

PREAMBLE

WE, THE PEOPLE OF INDIA, having solemnly resolved to constitute India into a [1]**[SOVEREIGN SOCIALIST SECULAR DEMOCRATIC REPUBLIC]** and to secure to all its citizens :

JUSTICE, social, economic and political;

LIBERTY of thought, expression, belief, faith and worship;

EQUALITY of status and of opportunity; and to promote among them all

FRATERNITY assuring the dignity of the individual and the [2][unity and integrity of the Nation];

IN OUR CONSTITUENT ASSEMBLY this twenty-sixth day of November, 1949 do **HEREBY ADOPT, ENACT AND GIVE TO OURSELVES THIS CONSTITUTION.**

---

1. Subs. by the Constitution (**Forty-second Amendment**) Act, 1976, Sec.2, for "Sovereign Democratic Republic" (w.e.f. 3.1.1977)
2. Subs. by the Constitution (**Forty-second Amendment**) Act, 1976, Sec.2, for "Unity of the Nation" (w.e.f. 3.1.1977)
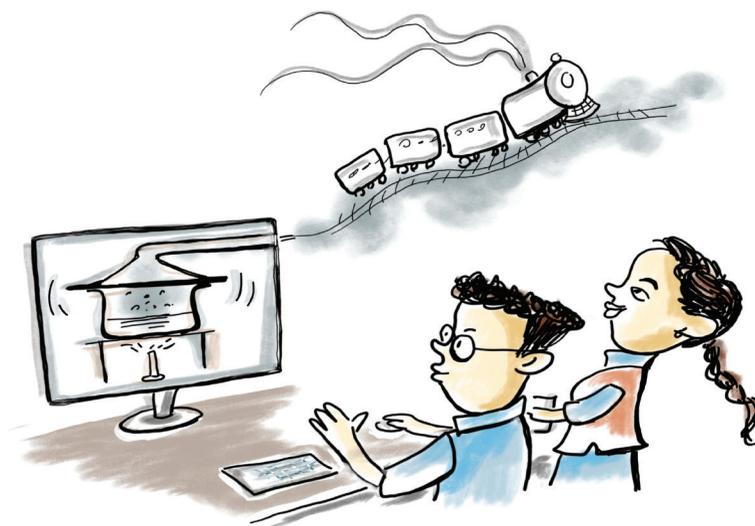
Chapter 7
Learning Science Through Computers

Many software applications are available today to make learning of science interesting and fun. Our operating system contains free educational software that helps in the study of sky watching, map study, elements and molecules. Virtual labs, simulation software, and interactive software can be used to observe and test various concepts. Let's try some interesting activities using such software.

7.1 See the Midnight Sun

"The 'white nights' of Finland were a fascinating experience for us Indians. Our hostel building is on the banks of a lake in Otaniemi. When I look out the large window in my room on the fourth floor, can clearly see a part of the lake. When we go to bed after dinner, we usually lower the thick curtains and invite in the darkness. Sometimes I wake up earlier than usual. I look at the clock and it's 3 am or 3.30. When I open the curtains, a bright light floods the room."

Given above is a part of S.K. Pottekad's travelogue 'In the land of the Midnight Sun'.

Have you ever wondered about the midnight sun? There are places like this on our planet. If you travel to cities near the polar regions, you can experience months of darkness-free nights.' These nights, celebrated by the locals as the 'White Night Festival', are a phenomenon experienced only by those who live in areas beyond the Arctic and Antarctic circles. Living in a land close to the equator, the sun rising at midnight is unfamiliar to us. Is it possible to see the sun rising in the midnight sky without going to Finland, Russia, Norway, or Canada?"

In previous classes, we learned that we can observe the sky from any location on Earth using the Stellarium software.

Stellarium

Stellarium is a free desktop planetarium software that simulates various views of the sky.

We can see past and upcoming celestial phenomena in it. This is a very helpful software for stargazing and sky watching.

Let's open Stellarium and observe a simulation of the sun rising in the midnight sky in regions beyond the Arctic and Antarctic circles.

To observe a celestial body in the Stellarium software, the following steps must be performed.

- Place of observation should be set.
- The observation time (date and time) should be set.
- You must select the celestial body to be observed..

To set Place of Observation

The view of the sun from the polar regions is different from the view of the sky from the equator.

Using Stellarium, you need to select a location north of the Arctic Circle to view the midnight sun. Using the Location Window feature in the Stellarium software, set the observation location to the city of Tromso, Norway.

To Set the Location in Stellarium Software

▪ Click on the Location Window (F6) tool at the top of the toolbar.

▪ Type the location you want to search for in the Search bar in the Location window.

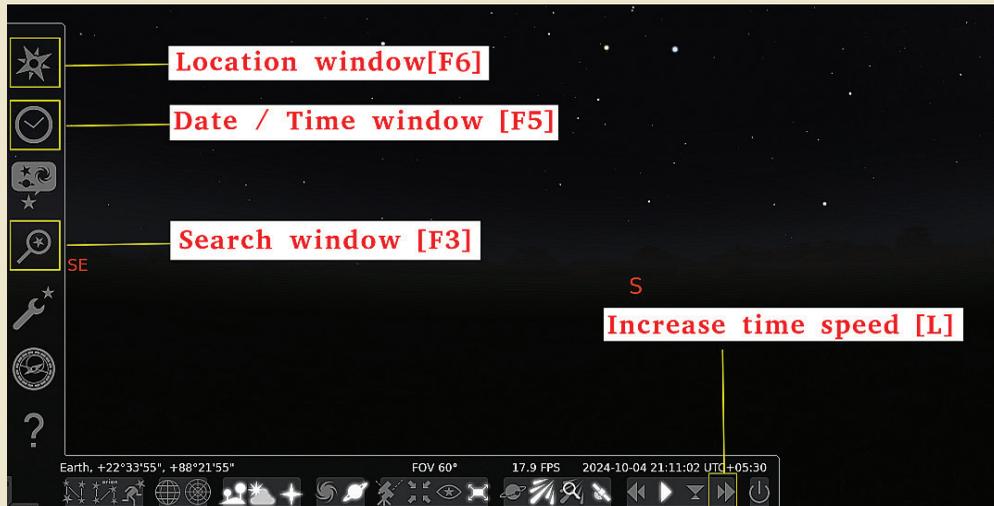▪ Select the exact location from the search results.

Fig. 7.1 Stellarium Main Window

▪ You can also adjust the location by clicking on the map in the Location Window. Click at the point to observe.

▪ If the location is not accurate, just click Reset Location List and adjust the location again.
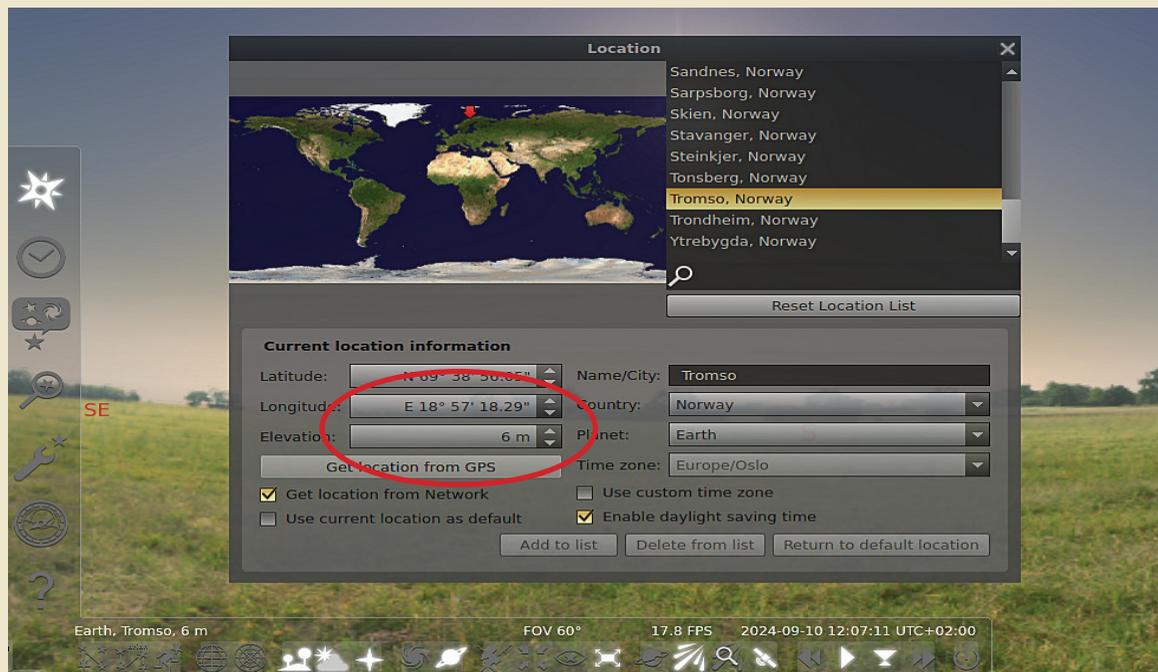
Fig. 7.2 Stellarium- Location Window

Haven't you selected the city of Tromso as an observation point? Make sure that the location details now visible in the window are the same as given below.

Details of the town of Troms		
Name/City	:	**Tromso**
Country	:	**Norway**
Latitude	:	**N 69^0 38' 56.05"**
Longitude	:	**E 18^0 57' 18.29"**

Next, let's set the observation time.

To Adjust Day and Time

In places north of the Arctic Circle, the midnight sun is visible during summer. The Northern Hemisphere experiences summer in the months of June and July.

What if we chose the last day of the solar eclipse, the summer solstice (June 21), to observe the sun?

Arrange the observation day in the time setting window for 21st June at six o'clock in the evening.

To Observe from the Moon

- Click on the Location Window (F6) tool at the top of the toolbar.
- In the window that opens, under the map, select Moon under Planet.
- A list of locations included in the software will appear. You can select the desired location and set the location.
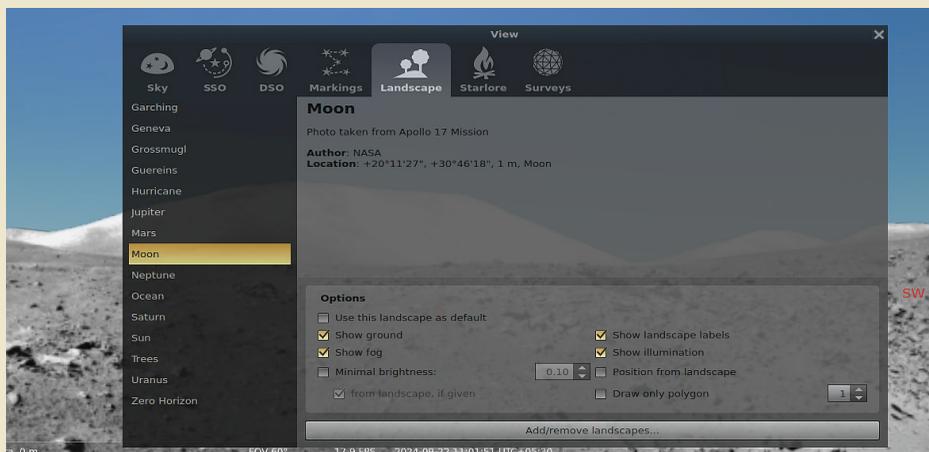
Fig. 7.3 Stellarium - Landscape Tab

To get the impression of observing from the lunar surface in the Stellarium,

- Click on the Sky and Viewing Options window [F4] in the toolbar.

- Select the Landscape tab in the window that opens and select Moon from the list on the left.

To set the observation date, click on the window available when selecting the Date/Time Window (F5) tool on the toolbar. Just arrange the required time.
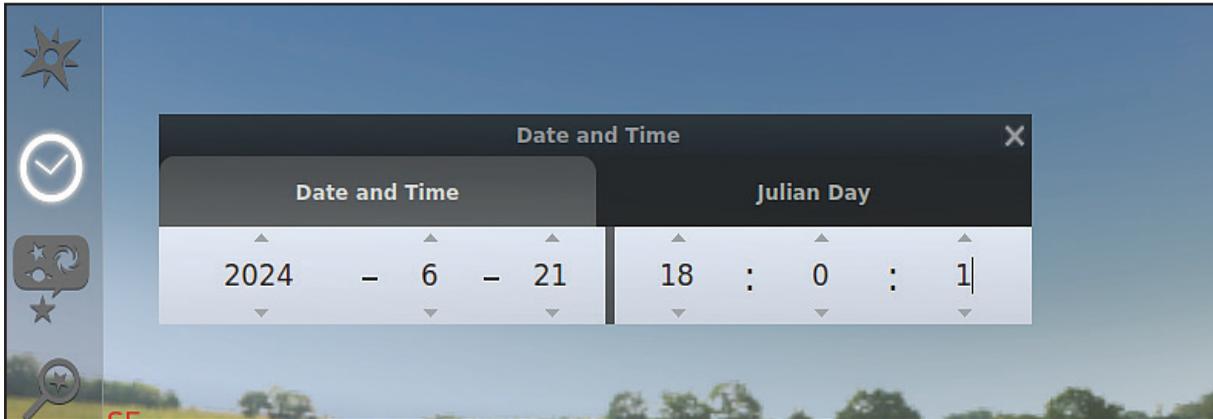
Fig. 7.4 Date and Time window in Stellarium

Tromso

Tromso is a city in northern Norway, located 300 kilometers north of the Arctic Circle. This city, often called the gateway to the Arctic, was where early Arctic exploration began.

From May 18 to July 26, the midnight sun rises in Tromso. Between March 27 and September 17, there is no night in Tromso unlike in India. From November 26 to January 15, Tromso experiences polar night. During this time, the sun goes below the horizon.

Let's Observe the Sun

Now, let's look at a simulation of the sun at night from the city of Tromsø, Norway.

There are millions of objects in the sky. Now we need to show exactly which object we are observing. To make the midnight sun visible, search for the sun in the Stellarium search window.

To Search for Celestial Bodies in Stellarium

- Click on the Search Window (F3) tool in the toolbar.

- Type the name of the object you want to search for in the search bar and press Enter (to search for the Sun, just type Sun).
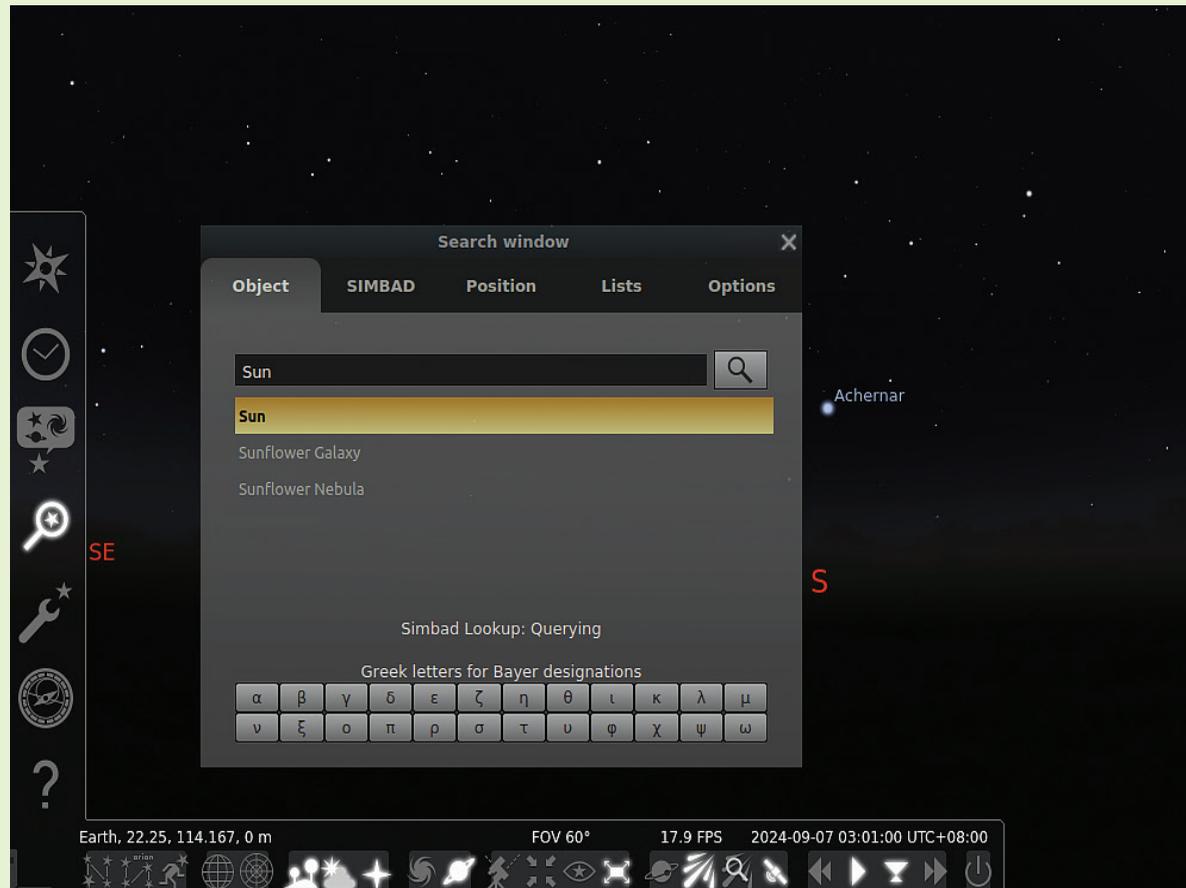
Fig. 7.5 Search W indow in Stellarium

Now close the search window. Isn't the sun visible in the sky in the software window?

White nights

White nights are a phenomenon experienced during the summer in areas north of the Arctic Circle and south of the Antarctic Circle. In the Northern Hemisphere, the white nights occur during the weeks leading up to the summer solstice in June. During this time, sunrises are earlier and sunsets are later. In the polar regions, the sun is visible all day long. In the Southern Hemisphere, this occurs in December.

Many cities north of the Arctic Circle in countries such as Russia, Norway, and Finland

hold all-night celebrations during this time. These celebrations are known as White Night Festivals. The White Night Festival held in St. Petersburg, Russia, is famous.

Then, open the Date and Time window, click on the minute and continuously change the time to observe the sun's path.

Record the direction in which the sun is visible in Table 7.2. Use Table 7.1 to understand the direction.

Direction Indicators	Directions
N	North
NE	North East
E	East
SE	South East
S	South
SW	South West
W	West
NW	North West

Table 7.1 Direction Indicators in Stellarium

If you don't see the direction on the screen, just zoom in and zoom out by moving the mouse scroll wheel.

Date	Time	Position of sun (Direction)
June 21	0 : 30 : 0	North
	4 : 0 : 0	
	7 : 0 : 0	
	10 : 0 : 0	South-East
	12 : 30 : 0	
	15 : 0 : 0	
	18 : 0 :0	
	21 : 30 :0	
June 22	0 : 30 : 0	
	3 : 0 : 0	
	6 : 0 : 0	East
	9 : 0 : 0	
	12 : 30 : 0	
	15 : 0 : 0	
	18 : 0 : 0	
	21 : 30 : 0	North West

Table 7.2 Position of the Sun at Different Times

Solstice

At the end of the Northern Solstice, the Sun is directly overhead at the Tropic of Cancer on June 21, known as the Summer Solstice. This day has the longest day and shortest night. At the end of the Southern Solstice (December 22), the Sun is overhead at the Tropic of Capricorn, marking the Winter Solstice, when the Northern Hemisphere experiences the longest night and shortest day.

Observe the sunrises and sunsets these days. What features do you see?

You can increase the speed of time by clicking on Increase Time Speed (L) in the status bar.

Click on it three times to see the movement of the sun as an animation.

You can see that the sun is visible in the sky all day long without going below the horizon. When you run the animation, make sure that the sun is in the selection, ok?

To set the time rate to normal speed, simply click on Set normal time rate (K).

Direction of the Sun During the Summer Solstice

Have you observed the movement of the sun during summer solstice in places north of the Arctic Circle?

Now, observe the journey of the Sun from sunrise to sunset from places located at different latitudes in the Northern and Southern Hemispheres on these days. Then, find the difference in the journey of the Sun and complete the table given below (Table 7.3).

Place	Country	Latitudinal Position	Direction of movement of Sun
Kuala Lumpur	Malaysia	3^0 8' 28.32" N	
Kolkata	India	22^0 33' 45.47" N	The Sun rose between the north east and the east. moved overhead, towards slightly north, and set between the north west and the west.
Anchorage	United States of America	61^0 13' 5.01" N	
Talnakh	Russian Federation	69^0 29' 11.41" N	
Alice Springs	Australia	23^0 41' 50.93" S	
Sydney	Australia	33^0 52' 4.26" S	
South Pole Telescope	Antarctica	90^0 0' 0.00" S	

Table 7.3 Sunrise and Sunset Times at Different Latitudes

Let's evaluate

* Which of the following planets makes it impossible to observe celestial bodies in the Stellarium software?

  a) Mercury   b) Venus   c)   Uranus d) Neptune
* Which of the following locations in the Stellarium software can be used as an observation point to view the midnight sun?
  a) Alice Springs   b) Kuala Lumpur   c) Sydney   d) Talnakh

Extended activities

1. Observe the Earth from the Moon and find the difference between day and night in the northern and southern hemispheres during different months and record it in a table.

2. Observe the solar eclipse that occurred in Dallas, the United States, on April 8, 2024 at 1:40 PM in Stellarium. Then find the start and end times and record them in your notebook.

7.2 Resource map

Fig. 7.6 Poster showing International Disaster Risk Reduction

You have seen the poster of the International Day for Disaster Risk Reduction celebration organized in the school under the leadership of the District Disaster Management Authority (Figure 7.6). October 13 is observed as the International Day of Disaster Risk Reduction every year to reduce the risk of disasters worldwide by raising public awareness about the risks and the precautions we need to take to face disasters.

Natural disasters are a big challenge for any society. Kerala has witnessed various types of natural disasters in the recent past. Let's take a look at the major natural disasters that Kerala has witnessed in the last few years.

§ Flood

§ Landslide

§ Soilslide

§ ....

Governments are devising and implementing various measures prevent natural disasters. Adopting measures to prevent disasters, taking actions to address inevitable ones,

conducting post-disaster rescue operations and raising public awareness are all part of disaster management.

Discuss with your friends what things your school can do as part of disaster management activities and write them down in your notebook.

- Participate in disaster relief operations.
- Implement nature conservation activities.
- Organize awareness activities.
- ....
- ....

Disaster risk area maps can play a major role in planning precautionary measures related to natural disasters and effectively dealing with natural disasters.

Disaster Risk Area Maps

A disaster risk area map is a map that highlights the vulnerabilities and potential hazards of a specific area. It indicates where damage is likely to occur during a disaster and suggests what precautionary measures can be taken. The importance of such a map is outlined below:

- **Precautions:** Helps in identifying areas prone to disasters and taking necessary safe guard in advance.
- **Planning:** Aids in planning disaster prevention activities and in the efficient allocation of resources.
- **Response:** Assists in determining where to begin rescue and relief operations during a disaster.
- **Awareness:** Helps educate the public about potential disaster risks and enables them to learn self-protection measures.

A disaster risk area map is an important tool for understanding the vulnerability of an area, identifying risks, and strengthening the process of disaster mitigation.

Geographic Information System software can be used to prepare disaster risk maps. The Kite GNU Linux we use includes a geographic information system software called Quantum GIS. Using this, we can perform various types of analysis and prepare resource maps that can anticipate disaster

situations, which helps in taking precautionary measures, planning and developing an action plan.

Geographic Information System Software

Geographic Information System software is a software system for recording the features and spatial information of the Earth's surface in multiple layers. Geographic Information System software can store and analyse information. Quantum GIS, GRASS, and Arc GIS are the leading geographic information system software. Of these, Quantum GIS and GRASS are free software.
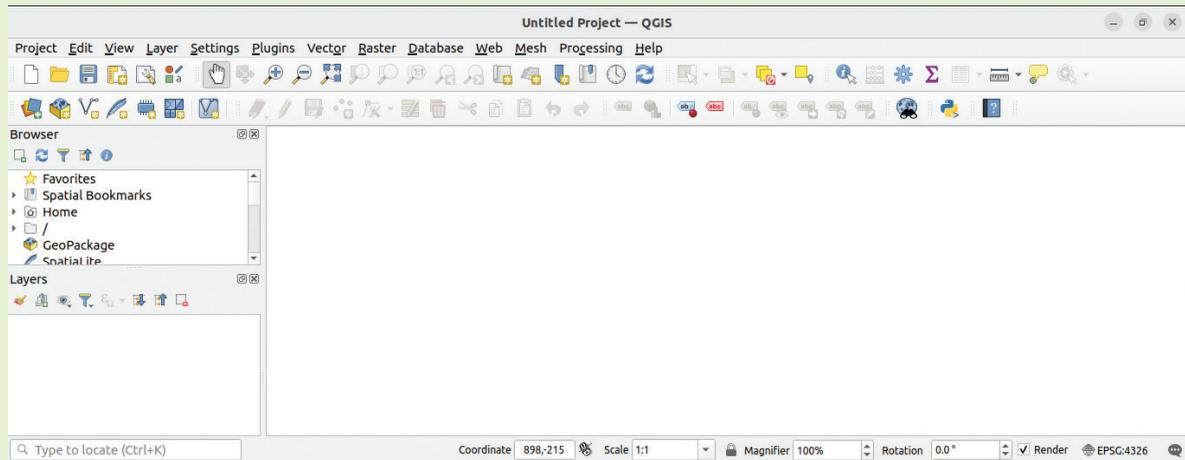
Fig. 7.7 Quantum G.I.S Window

Haven't you heard about how climate change at the global level is causing natural disasters in places including Kerala?

School G.I.S

School GIS (https://schoolgis.nic.in/) is an online geographic information system portal designed to make information about schools across the country available to the public.

Landslides are a natural disasters that Kerala faces. Details of major landslides that have occurred in Kerala have been recorded in a data set named kerala_landslide_catalogue_point.csv in the School_Resources/Class_10 in QGIS folder.

Let's see how to include this file into a QGIS map and examine the information recorded in it. To do this, follow the steps given below.

To check the resource map in QGIS software

- Open QGIS and click Project → Open to open the map QGIS/Kerala provided in the QGIS/Kerala folder.

We can add data on major landslides in Kerala in a new layer to this map. For this,

- Click on Layer → Add Layer → Add Delimited Text Layer in the menu bar.

- In the opened Data Source Manager | Delimited Text window, click Browse in the File name section and select the data-containing file named kerala_landslide_catalogue_point. csv.
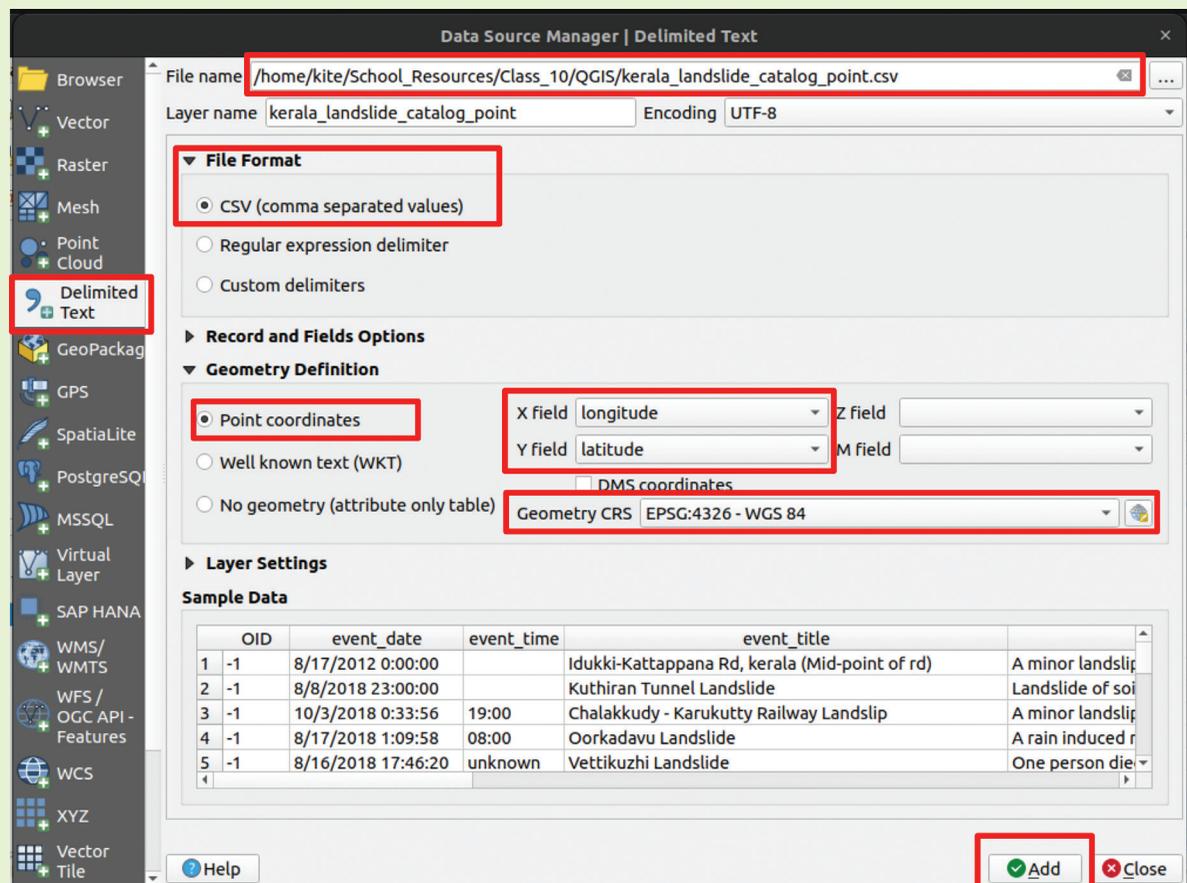

Fig. 7.8 Qgis – Source Manager Window

- Make the following settings in the window.

    - File Format : CSV (Comma Separated Value)

    - Geometry Definition : Point coordinates

        - X Field – Longitude, Y Field – Latitude

- Geometry CRS : EPSG:4326 – WGS 84
- Then click Add.
- Now, close the Data Source Manager | Delimited Text window.

With this, you will see that the data we have included in a new layer (Layer Type - Point) is depicted on the map. To view information about any point recorded on the map,

- Select the new layer.
- Then click on the Identify Features tool and click on the point where you want to get the data.
- The data of the (landslide) recorded there will be displayed in the window that opens.

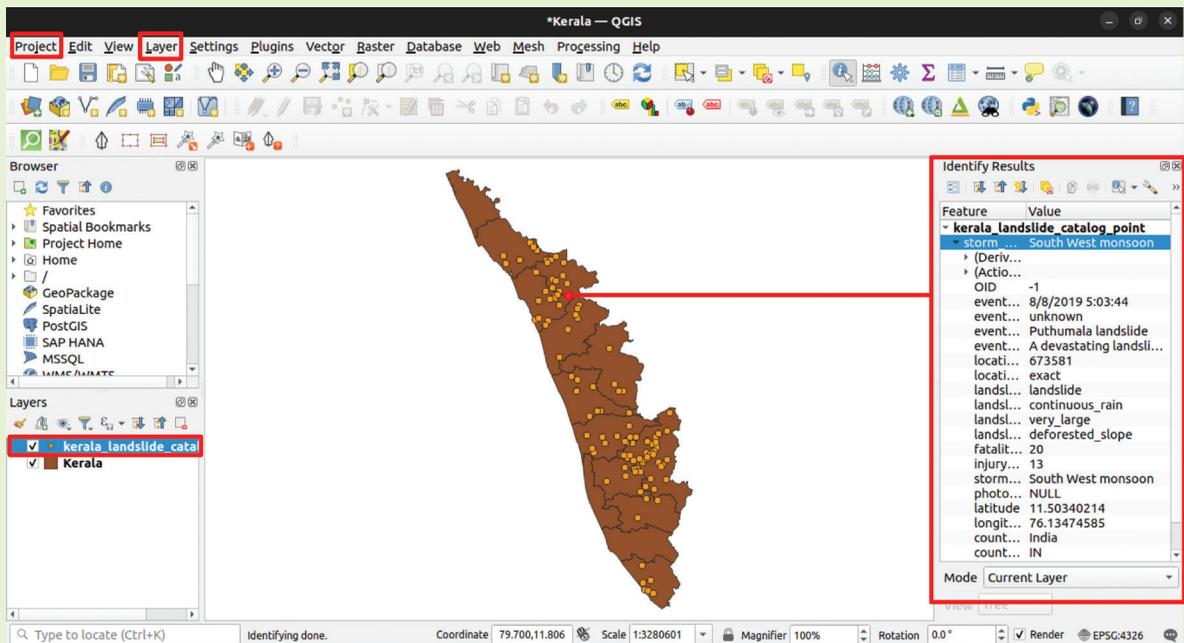Fig. 7.9 Data From the CSV File Displayed on a QGIS Map

To see a list of all the information recorded in a layer, right click on the layer and simply open the Open Attribute Table.

Use the Identify Features tool to click on points in each district on the map and examine the details recorded on it.

In this way, find information about landslides in various districts of Kerala from the map and complete Table 7.4.

District	Places where landslides occurred	Date	Time	Reason	Latitude	Longitude
Kannur	(1)					
	(2)					
Wayand	(1) Puthumala	8/8/2019	5:03:44	Continuous rain	11.50340214N	76.13474585E
	(2)					
Kozhikode	(1)					
	(2)					
Malappuram	(1)					
	(2)					
Idukki	(1)					
	(2)					

Table 7.4 Details of Landslides

Let's Check the Possibility of Landslides.

The table shows the common causes of landslides (Table 7.4).

QGIS software can also be used to prepare maps of landslide-prone areas. See what information is needed for this.

- The slope of an area
- Rock structure
- Land use
- Amount of rain
- ....
- ....

Digital Elevation Model (DEM)

A digital elevation model is a 3D graphical representation of data representing the elevation of a planet, a region of the earth, or objects on its surface. DEMs are used in geographic information systems.

Shall we create a map in QGIS that would help us understand the slope of places in Wayanad district?

For that, we need the DEM (Digital Elevated Model) data of the district .

A file containing DEM data for Wayanad district is stored in the QGIS folder on the computer as an image file named DEM_Wayanad.tif. Let's see how to perform the above operation using this file.

To Find Out the Slope Details of an Area

- Open the QGIS software and start a new project via Project →New.

- DEM data is available as a raster image file. To add it to a map,

- Click Layer→ Add Layer → Add Raster Layer.

  - In the Data Source Manager | Raster window that opens, make sure Source Type → File.

- Then, browse to the Source Raster Dataset section and select the required Raster Layer / DEM (Eg: DEM_Wayanad.tif) and add it.

- Then select the new Raster Layer and click Processing Toolbox in the Menu bar.

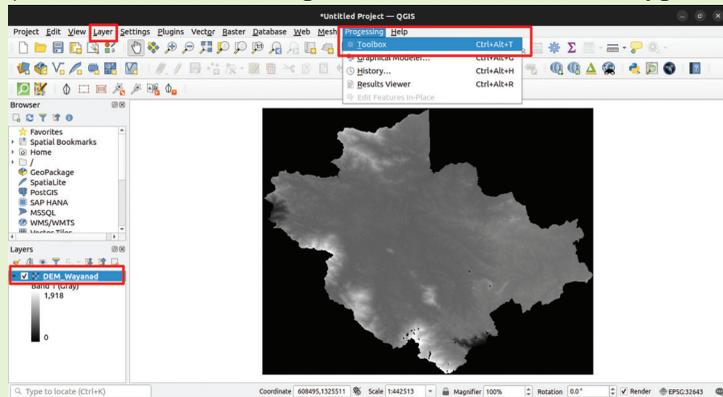This will display the Processing Toolbox on the right side of the window.

- OpenGDAL → Raster analysis → Slope in the toolbox and double-click on Slope

Fig. 7.10 DEM The Way to Add a File in the Map - Step - 1
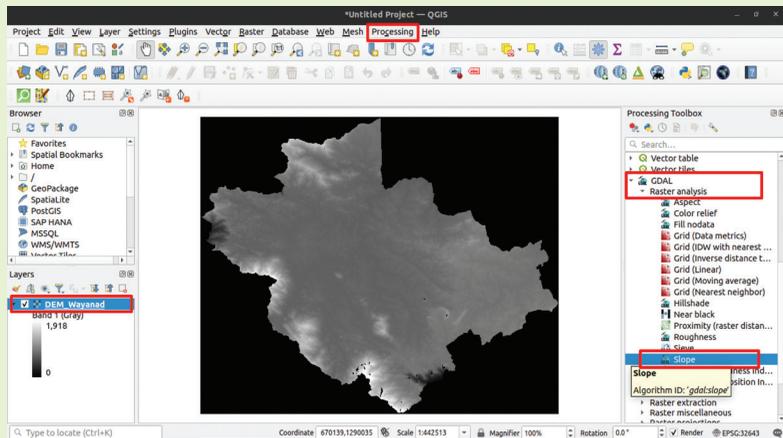
Fig. 7.11 How to Add a DEM File to a Map – Step 2

- In the Slope window that opens, make sure that the raster layer (DEM Wayanad) is active in the Input layer

- Make sure the ratio of vertical unit to horizontal value is 1.

- In the Slope section, select the location where you want to save the newly created Slope layer, give it an appropriate name (Slope) and save it.

- Then click Run to complete the layer creation process. You can then close this window.
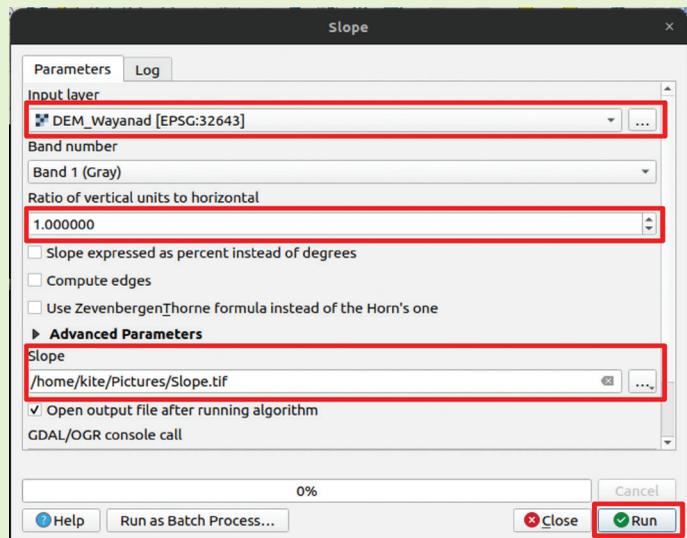
Fig. 7.12 Settings When Adding a DEM File to a Map
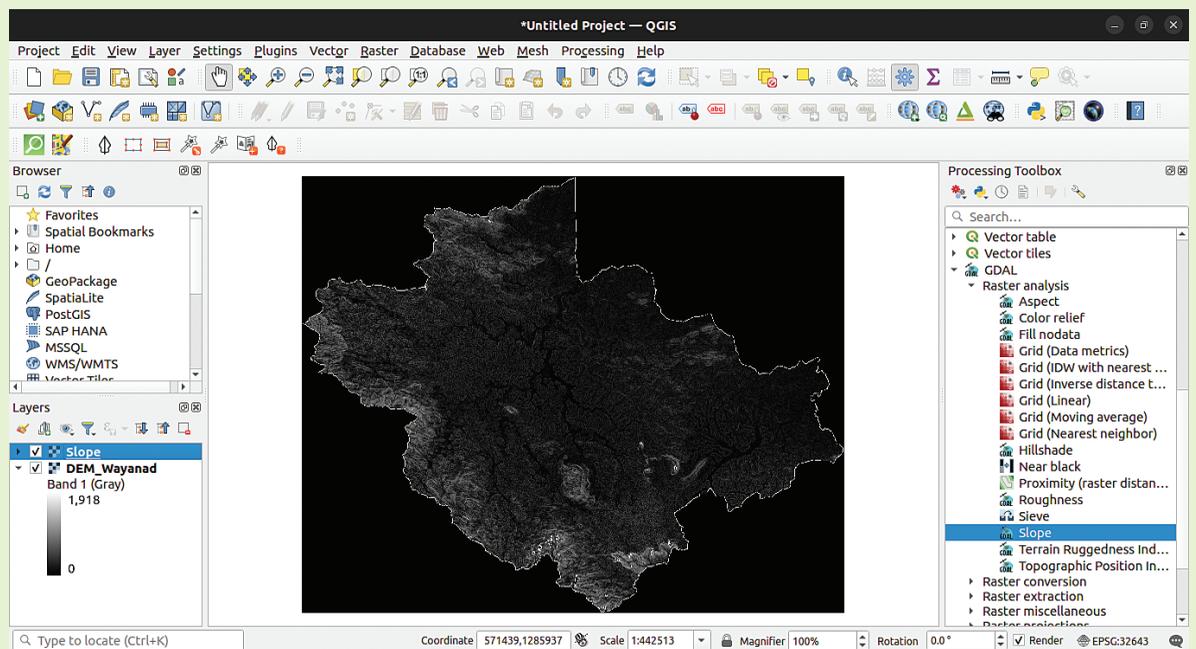
Fig. 7.13 Slope Analysis Map of Wayanad

Didn't you get a new map when you completed the above task?

What is the peculiarity of the map that is now available?

➢ The slope of the area cannot be understood from this map.

➢ Since it is a single-colour (single-band) map, it is also difficult to understand the slope information.

To solve this, we can give different colours to the map according to the slope of the area. That is,

➢ Areas with a certain degree of slope can be given the same colour.

➢ Different colours can be assigned to represent different slopes.

To do this, try the steps given below.

To Give Different Colours to the Slopes

▪ Right click on the newly created Slope layer and open Properties.

▪ Then make the necessary changes to the Symbology in this window.

    ➢ Render type : Singleband pseudocolor

    ➢ Interpolation : Linear
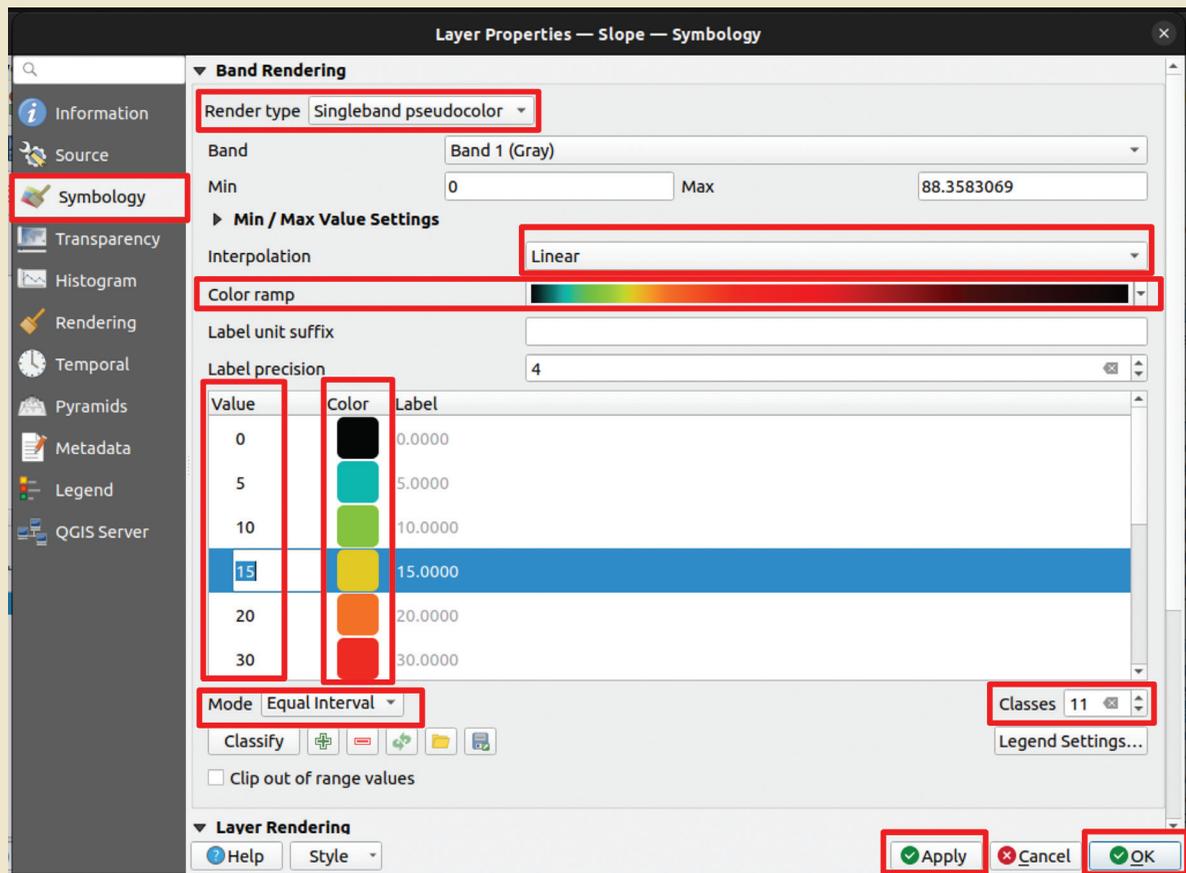
Fig. 7.14 Settings to Give Different Colours to the Slope

- Color ramp: Spectral - Invert color ramp (27.14)

- Mode : Equal Interval

- Classes: Appropriate number.

- Label Value: Places with a certain degree of slope can be considered as each category and each category can be given a different colour. (Example: 0, 5,10, 15, 20, 30, 40, 50, 60, 70, 80). The colours of other categories should be different from the colour given to one category.

  - You can change the label value by double-clicking on Value.

- To change the colour - Double-click on the colour box next to Label Value and select the appropriate colour from the window that opens.

- After making changes, click Apply and then click OK.
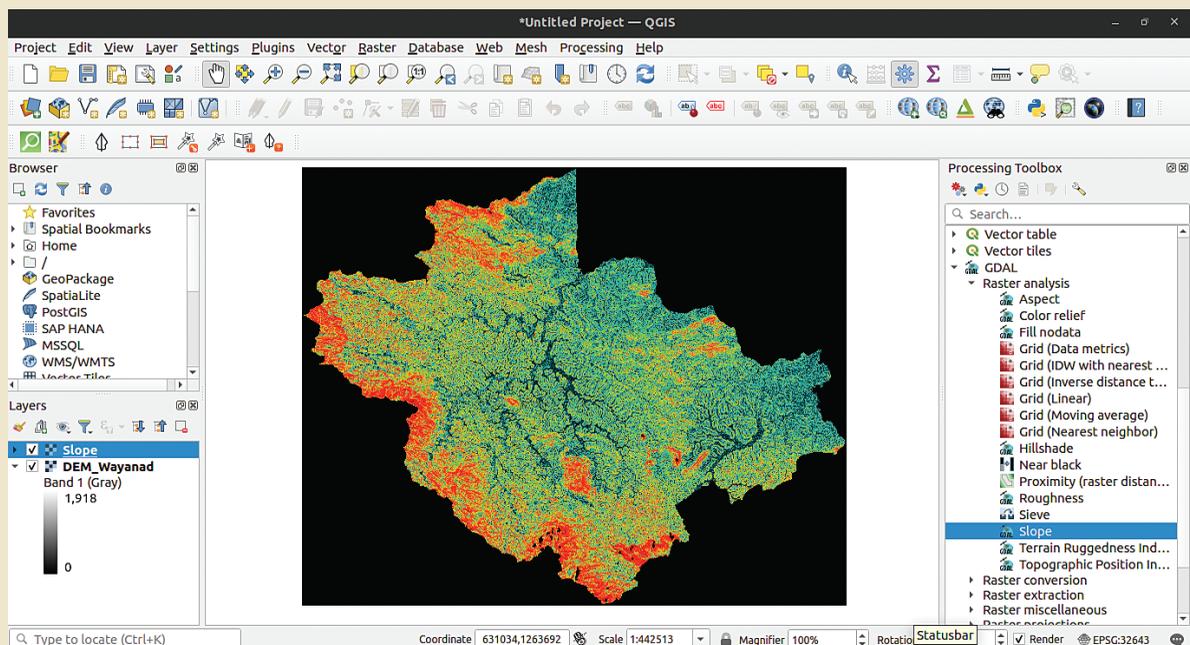
Fig. 7.15 When Different Colours are Given to the Slopes

Now the slope of the map is available in different colours. Now, you can print this analysis map and use it. Don't forget to save the project in your folder.

Printing the Map

To print the map we have prepared, we can use the New Print Layout feature in Quantum GIS.

Print the map you have prepared as an image file as shown below.

To Print the Map

- In QGIS, select New Print Layout from the Project menu.

- In the next window, give the map a title and continue.

- Then, in the window that opens, click the Add Map button and drag the map diagonally on the canvas using the mouse.

- You can add the necessary information to the map using tools like Add New Label and Add New Legend.

- Then, export the map using the Export As option in the Layout menu.
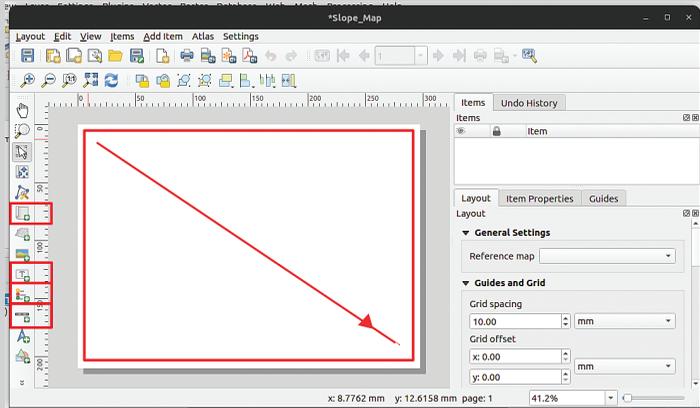
Fig. 7.16 New Print Layout Window
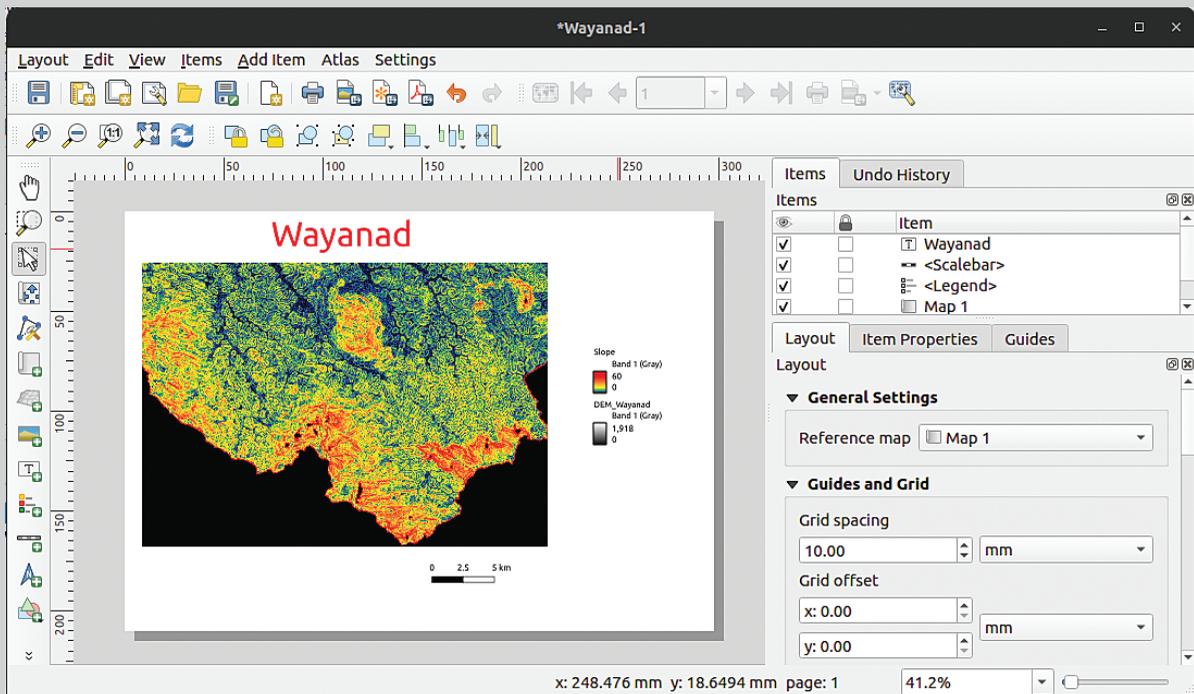
Fig. 7.17 When Map is Added in New Print Layout

Let's Assess

- Which of the following is an online geographic information system portal?

  a) Quantum GIS.   b) Grass GIS   c) School GIS   d) Map Info Pro

- Which of the following is not an open source geographic information system software?
  a)Quantum GIS. .   b) Grass GIS
  c) Arc GIS   d) Map Info Pro

Extended Activities

1. Open the Slope map we prepared and the Places_Kerala.gpkg file provided in the QGIS/ Other_Files folder in QGIS. Find and list the places in the steepest areas on the map.

7.3 Geometry of Equations
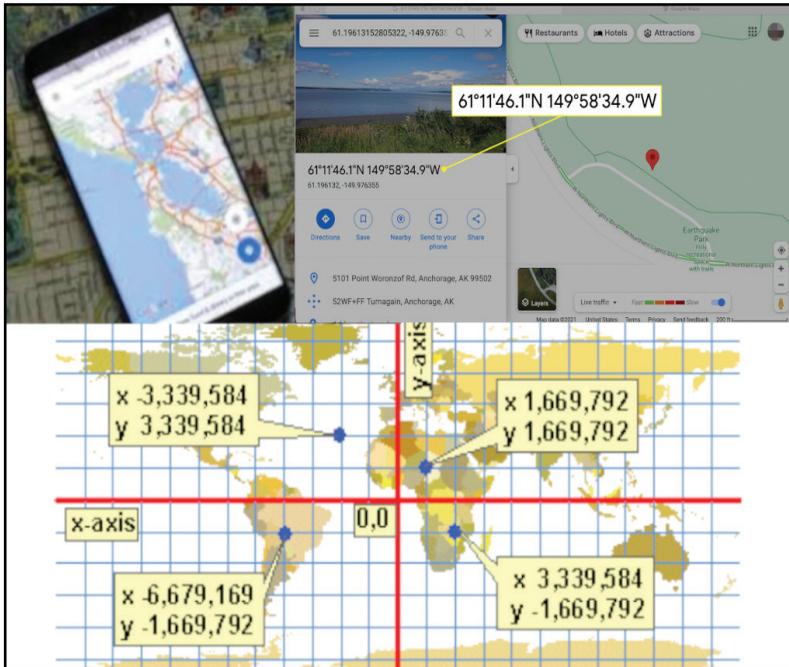
There are also index numbers at locations.

We know that the location of any place on this globe can be represented by latitude and longitude coordinates. Similarly, any point on a plane can be represented by a pair of numbers (index numbers). We have learned from math classes that the location of a point on a two-dimensional plane is determined based on the x-axis and the y-axis.

Look at Figure 7.18. What will be the index number of the point marked in this?
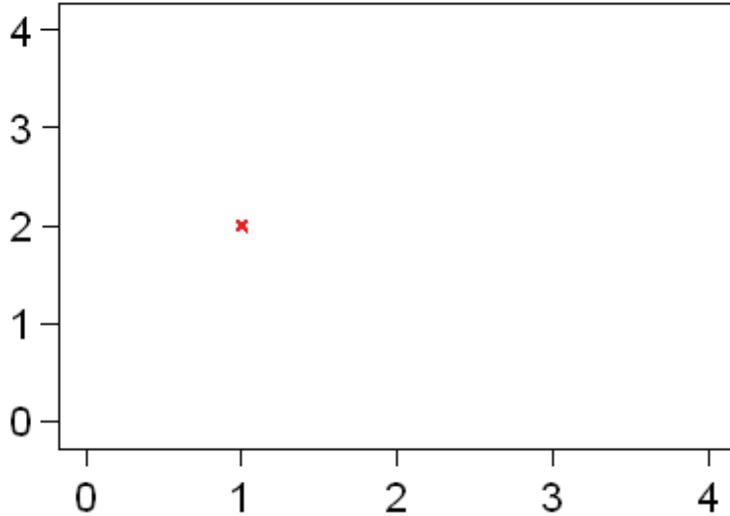
Fig. 7.18 Point Marked in a Plane

You have been introduced to GeoGebra software in previous classes, which helps you create geometric structures on a computer. Have you noticed that the index numbers of the points marked on the plane appear in the Algebraic View in GeoGebra?

Geo + Gebra = GeoGebra

The words Geometry and (Algebra) are coined to get the term Geogebra
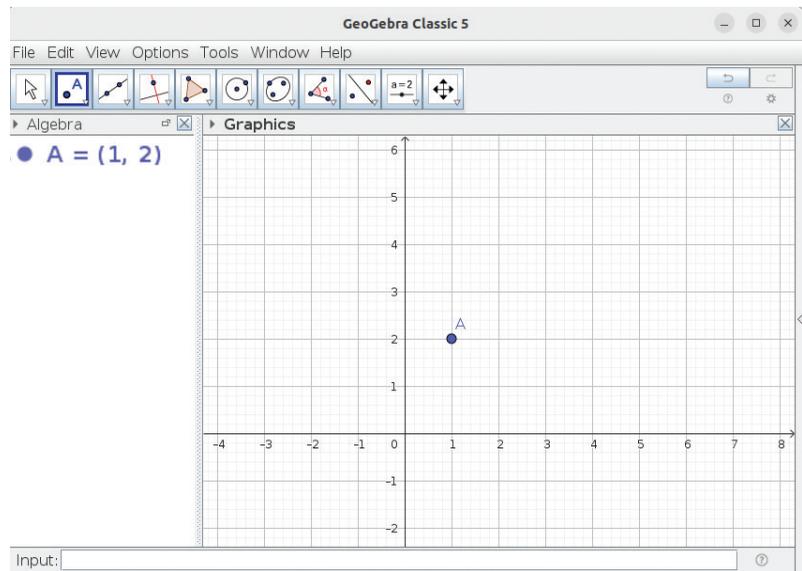
Fig. 7.19 GeoGebra Window

Indicative Numbers in GeoGebra

Open the GeoGebra software and draw points A and B on the plane as shown in Figure 7.20. Then construct a straight line passing through these points.

Remember that the positions of the points on the plane must be A=(3,2) and B=(1,4) respectively.

What tools did you use for this?

- ....
- ....

Now, check how the points and lines you just marked are indicated in Algebra View.
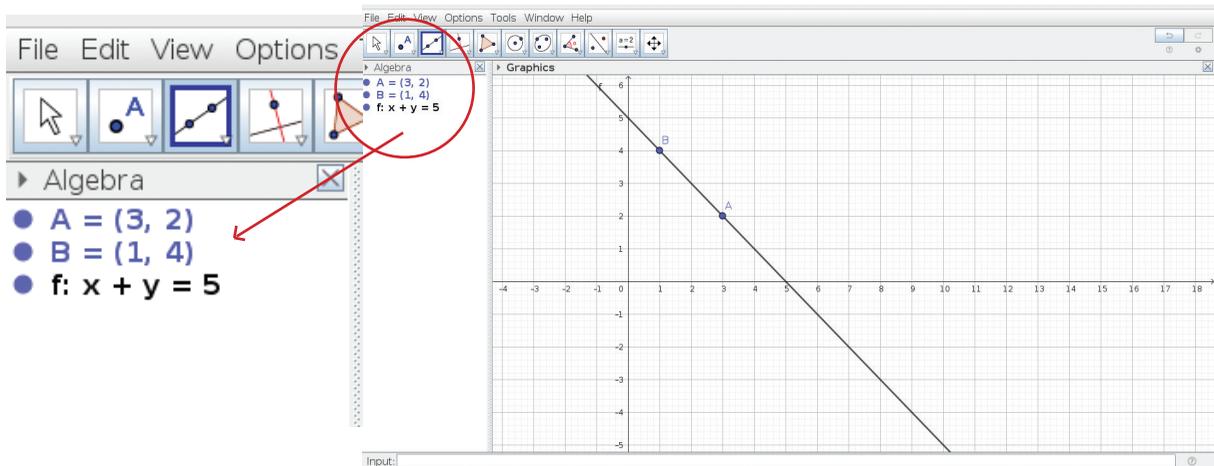
Fig. 7.20 Algebraic View in Geogebra

Now, two more points C and D are marked on this line. What change was observed in the Algebraic window?

Now, find the index numbers of the points you just created from the Algebra View window and write them below.

- ....
- ....

We have created structures using GeoGebra tools. Can structure be created in GeoGebra by entering index numbers?

Let's Draw without Tools

Type A(1,2) in the Input Bar at the bottom of the GeoGebra Algebraic View and press Enter. (Figure 7.21)

Point A appeared and on the screen without using the Point tool, did'nt it?.

Algebraic View

If the Algebra view is not visible when you open GeoGebra, check Algebra from the View menu. You can also display Algebraic View using the shortcut Ctrl + Shift + A.

Now, type B(1,3), C(1,4), D(1,5) one by one in the Input Bar and press Enter.
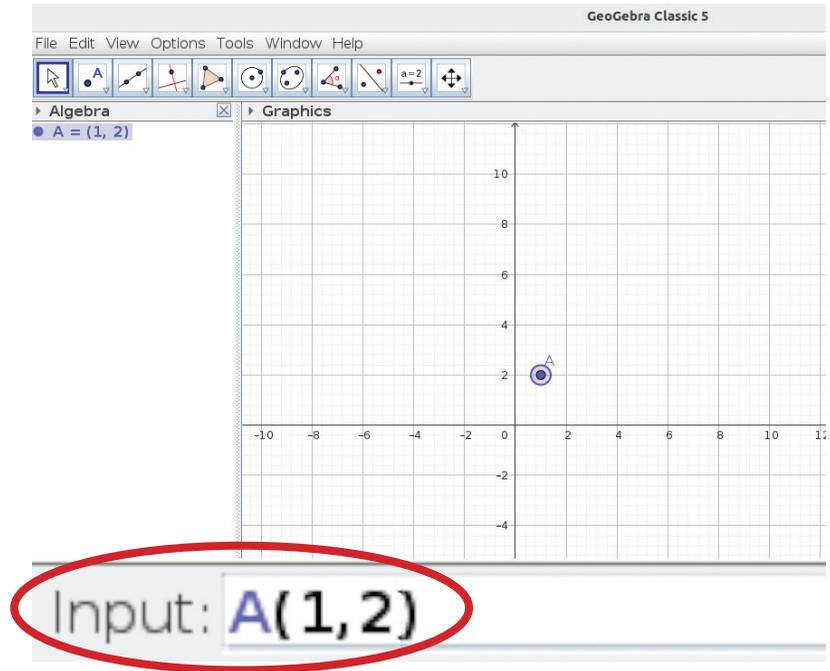
Fig. 7.21 Input Bar in GeoGebra

What is special about the points A, B, C, and D that are now visible on the screen?

- ....

Using a short line, we can connect all four of these points. Which tool should we use in GeoGebra to do this?

- Segment tool

Let's see how to draw this small line using the input method instead of using the segment tool.

Look at how the points marked so far are indicated in the Algebra view.

- A=(1,2)

- B=(1,3)

- C=(1,4)

- D=(1,5)

Input History

Place the cursor ↓, ↑   in the input bar, then press the Up Arrow and Down Arrow keys, to see the previously entered inputs.

In other words, we have now marked points A to D in GeoGebra.

Now, type Segment(A,D) in the input bar (Figure 7.22).
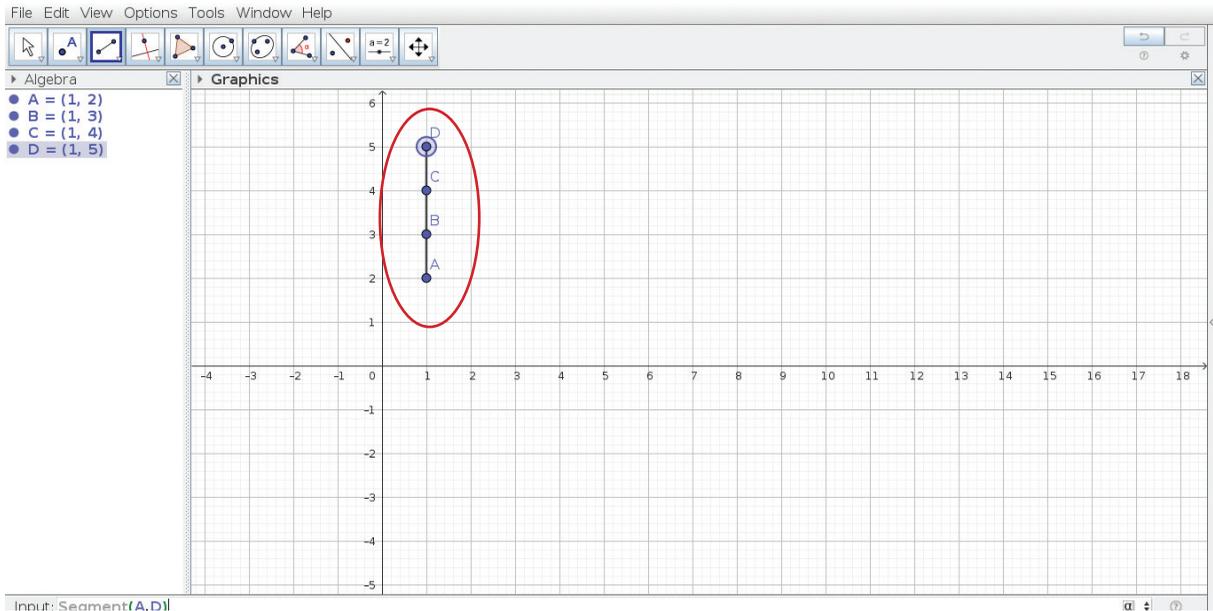
Fig. 7.22 Line Segment Drawn Using the Input Facility in GeoGebra

We now have a short line parallel to the y-axis. As you have learned from your math textbook, if you extend this short line to both sides, the equation of that line is x=1.

Then, try typing x=1 in the input bar (Fig 7.23)

Then, the equation of the line parallel to the y-axis is x=1.
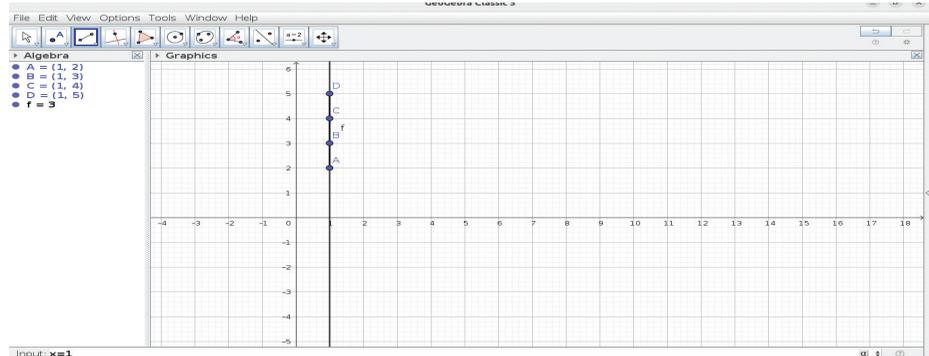
Fig. 7.23 Equation of the Line Segment in Input Bar

Some equations are given in Table 7.4. Complete the table by entering these equations in the Input bar in GeoGebra and observe the results obtained.

Equation	Features of the Constructions
y=2	
x=y	
x-y=5	No matter which point on the line is taken, the difference between its indices will be 5
y=2x	
2x+y=5	

Table 7.4 Equations and Features of the Constructions

More Constructions

So far, we have only created points, segments, and lines using the Input system. What if we created some other geometric shapes using Input?

Try typing the equation y = x2 in the Input bar..

What is the name of the shape you just got?

▪ ....

Quadratic Equations in the Input Bar

When typing quadratic equations in the input bar in GeoGebra, you must use the ^ symbol on the keyboard.

Example : $y=x\^2$

Now, enter the equation $x^2+y^2=2$ in the input bar and try constructing circles with different radii.

Let's Evaluate

♦ Which of the following would be an equation for drawing a line parallel to the Y axis using the input tool in GeoGebra?

a) x = 2   b) y = 2
c) x=2y   d) y=2x

☐ Which of the following constructions will be obtained if you type A(1,5) in the Input bar of GeoGebra software?

a) Pint   b) Line
c) Circle   d) Short line

Extended Activities

1. Draw a circle with centre A(1,4) and radius 2 units using the Input method in GeoGebra software.

2. Draw line segments y=2 and y=2x in GeoGebra software and find their intersection point using the Input method.

❖ ❖ ❖

Chapter 8
Let's Give Life to Pictures

Have you noticed the picture of a plant and a puppy in the lower right corner of the right page of our ICT textbook ?

Turn the page. You can see the same picture at the same place on the next page too.

And what about on the next page ?

Turn the pages one by one. Are the pictures same on every page?

Now, quickly turn the pages from the first page to the last page. What do you see?

It looks like as if the plant is growing and the puppy is looking at the plant wagging its tail, right ?

Have you ever wondered how this is possible ?

Notice that each page has different pictures of the puppy and the plant. These include different stages of the plant growing and the puppy wagging its tail.

When the continuous and sequential images of the movement of the puppy and the plant were rapidly captured one after the other by our eyes, they were perceived as a motion.

It is because of the unique feature of our eyes called 'persistence of vision' that the still images in the textbook seemed to come to life. It is by making use of this feature that the technology of animation came into existence.

Persistence of Vision

An image that falls on our eyes remains on the retina for a short time (one sixteenth of a second). This feature is called Persistence of vision. When another image falls on the retina during this time, we experience the second image as a continuation of the first image.

Let's Make an Animation Video

Animation is a field that quality interests all of us. Earlier we were familiar with animation through cartoon movies on television channels, but today we constantly see and make use of it in educational videos, advertisements, reels, and greeting messages.

In the past, animation films were made using painted plastic sheets. With the advent of computer technology, the animation technology has become more popular and the production has become relatively easier.

Let's Make an Animation Video

Phenakistiscope

Phenakistiscope

Phenakistiscope is the first device used to simulate animation. Sequential images of the various stages of an object's movement is drawn on the surface of a circular hardboard. When it is rapidly rotated using a stand, the object on the hardboard appears to move. Based on this technique, animations were created in the beginning of 19th century. The possibilities of animation were introduced with the help of devices like phenakistiscope during 1830s.

Didn't you notice a small animation hidden within the ICT textbook ? This is a Flipbook animation. Instead of that, shall we try to create a real animated movie ourselves ?

To create an animation, some preparations are necessary. Just like in the making of a film, play, or a documentary, an animated movie is also created through various stages.

Flipbook

A flip book is a type of illustrated book. It is also known as Flickr book and Kineograph. They are made by adding a series of images that change very gradually from one page to the next. When we look at these pages continuously, we feel that the images are moving.

There are websites and software packages available on the Internet today that can convert PDF pages and digital videos into desired Flipbooks. Search them in the Internet and try out.

You have learned in previous classes that for preparing a film or documentary, it requires a story, a script, characters, and dialogues.

Find out what all preparations are needed to prepare an animated film and complete the list given below.

- A theme is required
- Story based on that theme should be prepared
- The order in which the events in the story are presented, or the scenes should be determined.
- A story board including the details of each scene should be prepared
- ....
- ....
- ....

Let's prepare an animation to present on Environment Day

We have understood what all preparations are necessary to make an animation film. Based on this, let us now learn how an animation film is made.

An animation film should be made based on a particular theme or concept.

Now closely observe the flipbook animation included in the textbook. What is the theme of this animation? Discuss with your friends and find out.

Shall we consider this animation as a specific scene from an animated film that promotes environmental protection?

If so, think about what other situations there might be.

The plot of an animated film based on this theme, namely 'Luna', as prepared by some friends, is given below.

Luna (Animation Film) – the Storyline

A plant that has withered from not having enough water. A small puddle in the distance.

Small clouds in the sky.

A puppy (Luna) comes near the puddle.

The puppy makes a channel in the soil with its front paws and

brings the water to the plant.

You have seen the staryline of the animated film.

Which characters should be included when this story of Luna is made into an animated film?

▪ Luna

▪ ....

▪ ....

▪ ....

You have seen that a large number of images are required to create an animation. The story should be divided into different scenes based on the background and context in which they take place. The images should be designed with detailed illustration of the characters in each such scene.

Designing characters is a task that requires utmost care. It requires skill and expertise in drawing.

📖 Character Design

Character design is a very important step in animation production. It is the process of creating the characters in a way that suits the needs of the story. While designing characters, it would be good to take the following aspects into consideration as well.

▪ Variation in the shape of the characters

▪ Appropriate selection of colours

▪ Drawings that can be easily modified

With the advent of software-based animation production, creating drawings for animation has become much easier. Animation software usually includes built-in tools for drawing. It is also possible to create drawings using dedicated drawing software and then importing them into animation software to create the animation.

Different Types of Animation

Animations are created in 2D and 3D formats. 2D animation is a method of creating animation based on 2D images. Walt Disney's The Jungle Book, Bambi, Cinderella, etc. are famous 2D animated films. Open Toonz, Tupi Tube Desk, Synfig Studio, Adobe Animate, etc. are software that helps in creating 2D animations.

3D animations are created by preparing 3D shapes of the characters and backgrounds. Movies like Big Buck Bunny, Shrek, and Wall-E were created in this way. 3D animation is also widely used in games today. Blender, Autodesk Maya, and Adobe Dimension are examples of 3D animation software.

When Luna's story is divided into individual scenes, which are the characters to be included in the first scene? Discuss.

The next step in creating the animation is to convert the prepared story into a storyboard. A storyboard is detailed preparation of each scene in advance..

Based on the first scene of Luna's story, a sample storyboard has been provided below (Table 8.1). Discuss with your friends and prepare the storyboards for the other scenes using this sample as a model.

Titile : Luna					Page Number : 1		
Scenes	Background/ Characters	Action	Dialogue	Music	Time	Remarks
Scene 1	Withered plant, small puddle, sky	Clouds are moving in the sky		Background music	5 second	
Scne 2						
Scne 3						

Table 8.1 Model of a Storyboard

You've seen the storyboard for the first scene. Now let's create the animation based on this.

Towards Motion

We shall first prepare the scene that includes the movement of the clouds as described in the first scene. Let's create this animation using the OpenToonz animation software available on the school computer.

In our scene, we need a withered plant and a small puddle in the background. This animation will be possible only if we have images of all these.

We have already learned in previous classes how to create images using Krita, GIMP, and Inkscape. We can prepare the images using those software tools, or we can draw them directly in OpenToonz to create this animation.

OpenToonz

OpenToonz is a free animation software based on "Toonz" software developed by Digital Video S.p.A. in Italy. It provides tools for drawing, animation, and sound.

The Japanese animation film 'Belle' released in 2021 was created using OpenToonz software.

Open OpenToonz on your computer and create a project for the first scene.

To Create a Project in OpenToonz

- Open OpenToonz software

- In the OpenToonz Startup window that opens, click New Project to create a new animation project.

- Enter a name for the project (here Luna) and click OK (figure 8.1)

- Click Create a New Scene in the OpenToonz Startup window

- Then, enter the name of the scene and video settings in the window that appears. (Figure 8.2)

Fig. 8.1 New Project Window

The animation we create will be available to us in the form of a video file. When creating an animation video, the quality and frame rate of the video files need to be set in advance in the video profile.
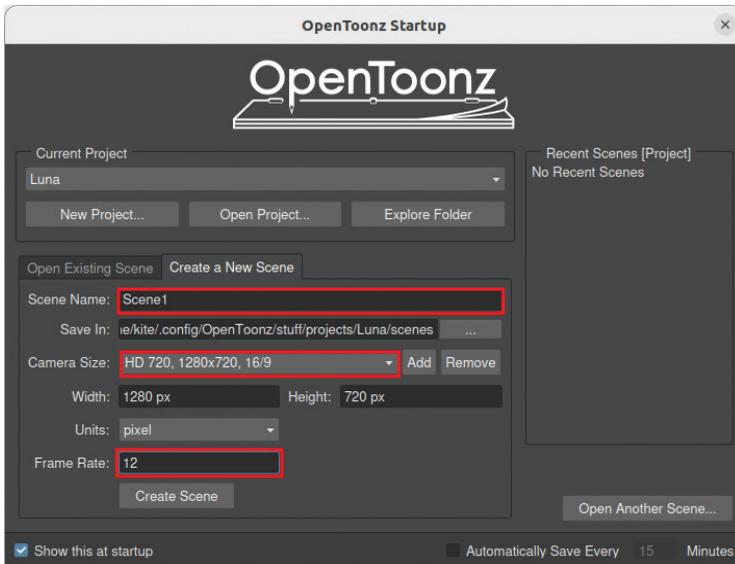
Fig. 8.2 OpenTooz Startup Window

The necessary settings for this also need to be entered in the OpenToonz Startup window.

A model of the settings that can be entered for video profiles in OpenToonz is given below.

Scene Name : Scene1
Camera Size : HD720,1280x720, 16/9
Units : pixel
Frame Rate : 12

Similarly, you may configure necessary settings for your animation project.

Once you provide the necessary settings for the first scene and click on Create Scene, the window required to create the animation will appear.

Did you get the OpenToonz window ? (See Figure 8.3)

Use the mouse scroll wheel to adjust the view so that the entire canvas is visible.
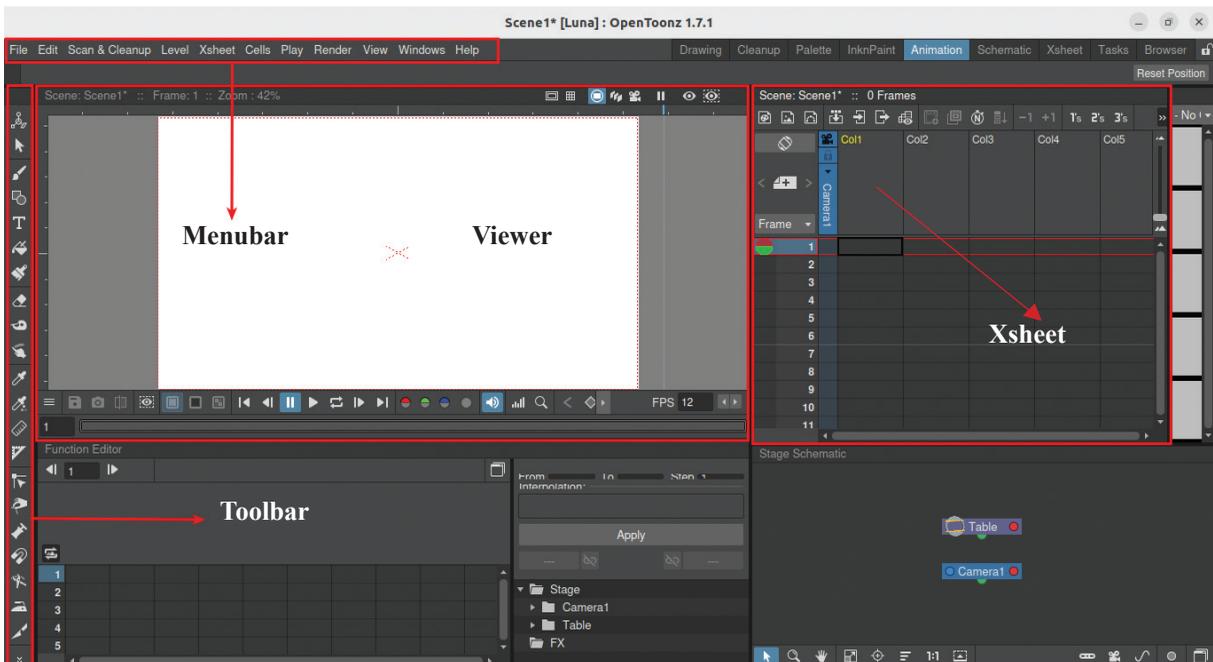
Fig. 8.3 OpenToonz Startup Window - Animation Room

Frame Rate

In animation, a frame can be considered as a still image. Animation is possible by displaying many such frames continuously. The number of frames displayed in one second is called Frame rate (Frame per second, FPS). This is a factor that determines the naturalness of the movement in the animation. We can set FPS according to the needs of each animation.

Let's Set the Background

According to our storyboard, in the first scene, we need to create a withered plant, a puddle, and clouds moving across the sky.

As mentioned earlier, animations can be created in OpenToonz by drawing the necessary images directly or by including pre-made images in the scene. Although simple images can be drawn using the drawing options provided in OpenToonz, it is more convenient to prepare and use complex images with the help of other drawing software that we are familiar with.

Xsheet

Xsheets are a feature available in OpenToonz for organizing the content of animation scenes. It is a concept similar to timelines in video editing software. Xsheets are arranged in different columns, with each column functioning as a separate track. Frames are arranged in the columns as cells.

Some of the images, image sequences, and audio files for preparing our animation are provided in the folder namely Class_10/Animation in School_Resources on the computer. These files may be used accordingly while creating the animation..

Arrange the Resources

In order to include the resources in OpenToonz, copy the Animation folder provided in School_Resources/Class_10 and paste it into the Documents folder in Home.

To begin with we will create background for the first scene. Check the image namely bg.png provided in the Animation/Scene_1 folder. Let's set this image as the background for our scene.

This should be done by opening the Animation Room in OpenToonz software.

Rooms in the OpenToonz

OpenToonz has separate rooms for different activities. These are also known as workspaces. When you open **OpenToonz** for the first time, the **Drawing** room opens.

Animation: This room is where you animate the position, rotation and size of the current objects.

Drawing: This room is used to draw, colour, and edit the drawings.

Open other rooms to find out what they are used for.
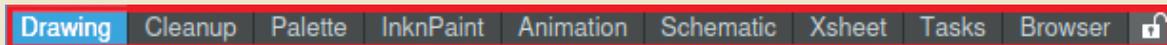
Fig. 8.4 Various Rooms in OpenToonz

To Include Image in OpenToonz

The background image should be included in the first frame of the first column.

For this,

- Select **Animation** room from the **OpenToons** window.

- Click on the first frame of the first column in the Xsheet.

- Click on **Browser** Workspace in the menu bar.

- Then browse to the folder where the images are stored from the window that appears.

- Select the image **bg.png,** Right-click and click **Load.**

- Click **Load** in the dialogue box that appears.
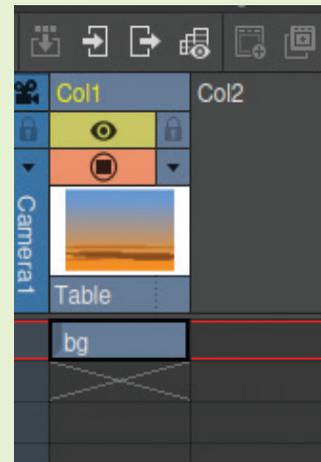
Fig. 8.5 When Imag
Included in OpenToonz

The background image has now been set in the window. Now, let's return to the Animation workspace.

Currently, the image we inserted appears only in the first frame. For the animation to work properly, this image must be included in the other frames as well.

We are creating a 5 second long animation with a frame rate of 12 frames per second as our first scene. So, think about how many frames are to be included in the first scene.

This image in the first frame has to be included in the remaining frames too (60 frames in total), right?

OpenToonz has a feature called Click and drag to repeat selected cells to copy the content in one

frame to other frames. Try using this to include the background image in other frames.

Once the work is completed, don't forget to click File → Save All to save your work.

To Include Images in Other Frames

- Click on the first frame in Col1.
- Click on the small button below this spell - Click and drag to repeat selected cells.
- Drag the button to include the image up to the required frame.
- This can also be done using the Repeat option too.

Now the background image has been added to all the
 frames of the first scene.

According to our storyboard, clouds are moving in the sky in the first scene.

Let's see how can this be done.

Draw a Cloud

The background is prepared using an image drawn in another software. What about drawing the cloud in **OpenToonz** itself ?

Simple images can be drawn with the help of the drawing tools of the OpenToonz software.

The background is in the first column. It is possible to give separate animations to the objects, if they are drawn in separate columns.

So, let's draw the cloud in the second column.

Repeat Button

The **Repeat** button can also be used to include the contents of a cell in other frames. To do this, select the image and click the **Repeat** button. In the window that appears, enter the number of frames and just click the **Repeat** button.
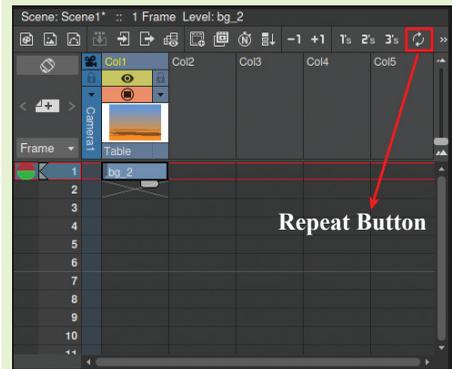
Fig. 8.6 Repeat option in OpenToonz

OpenToonz allows you to create images as raster files or vector files. Here we are drawing the cloud as a vector image.

To draw vector images, you need to set up the Vector Level window. Create a new vector level in the second column using the following steps.

We have understood the peculiarities of Vector images in the first chapter.

To Create Vector level

- Select the Animation Room.
- Click on the first frame in the column (here - Col2) you want to include from the Xsheet.
- Then, right-click here and select New Level.
- In the New Level window that appears, enter a name in the Name field (Cloud).
- Click the drop-down menu in the Type field and select Toonz Vector Level.
- Click OK.
- With this, you will see that a vector level named Cloud has been created in the selected frame.

New Level		✕
Name:	Cloud	
From: 1		To: 1
Step: 1		Increment: 1
Type:	Toonz Vector Level	▼
Save In:	+drawings	...
Width: 1920 px		Height: 1080 px
	OK Apply Cancel	
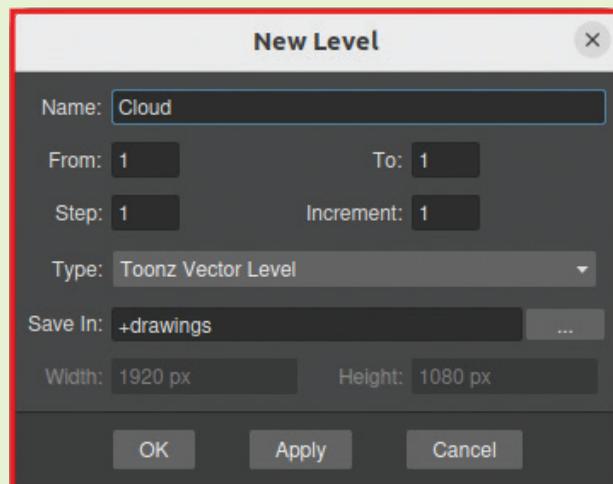
Fig. 8.7 OpenToonz New Level Window

A vector layer is created to draw the cloud. Now, draw the cloud using the drawing tool.

We are now in the Animation room. Find out the room for drawing the images.

To draw images in OpenToonz

- Select Drawing Room.
- Select Brush tool from the Toolbox to draw images.
- Then draw the cloud.
- Select the required colour from the Style Editor (Figure 8.9).
- The drawn image can be erased using Eraser Tool.
- Click inside the shape using Fill Tool to add colour.
- To get a new colour, click New Style and select the desired colour.
- Adjust the drawn image to the required size using the Selection Tool.
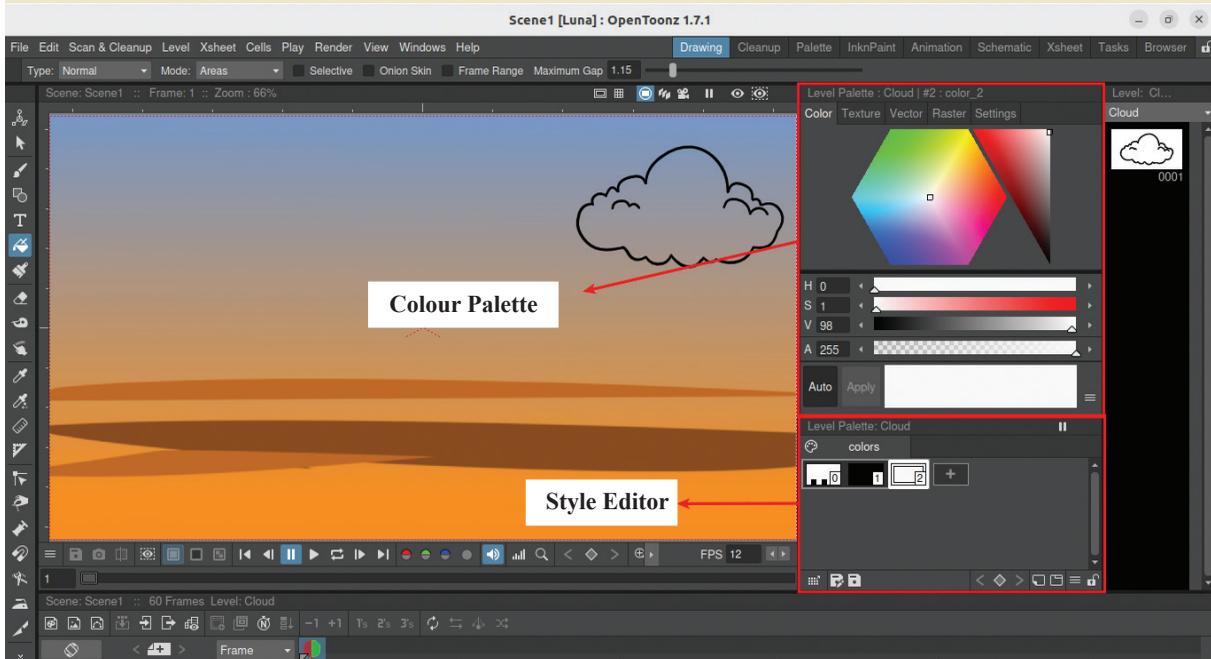
Fig. 8.8 OpenToonz Drawing Rooml Window

Try varying the Size, Accuracy, Smooth etc., while selecting the Brush tool to draw the image. What difference does it make?

Have you finished drawing the cloud ?

Now, we need to include this image in all 60 frames of the scene. Try doing it the same way as in the previous activity.
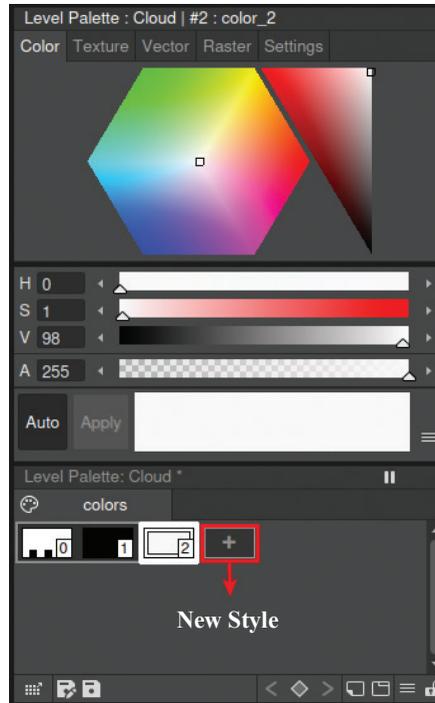
Fig. 8.9 Style Editor Window in OpenToonz

We have already seen some of the tools in OpenToons. What are the other tools in the toolbox? Try them and complete Table 8.2.

Fig. 8.10 OpenToonz Toolbox

Tool	Name	Tool Use
		To adjust the position, rotation, size of the objects
	Selection Tool	
		To draw geometrical figures
	Type Tool	

Table 8.2 Some of the Tools in OpenToonz and their Uses

Let's Add Motion to the Images

We need to create an animation in which a cloud moves from one side of the sky to the other. Let's see how to create this animation.

The movement of the cloud from one side to the other should be completed in 60 frames. In order to make this possible, the position of the cloud must change frame by frame according to its path of motion. That means we need to draw 60 different images, that differ in the position of the cloud drawn on the canvas, from one side to the other.

Instead, if we determine the position of the cloud in the first frame where the movement begins and the position in the frame where the movement ends, what if there was a technique where the software itself prepares the position of the cloud in each frame between them? OpenToonz also has the ability to create animations using a technique called tweening, which is commonly available in animation software. Try creating an animation of a cloud moving from one side to the other using Tweening animation.

Key Frames

When using tweening to create animation, the software must be able to predict the position and size of the object in each frame. This is based on the objects in some key frames that the animator determines. Keyframes are frames that are determined as important positions in the direction of movement in the animation. In OpenToonz, tweening animation can be created based on the Position, Scale, Rotation, Shear, and Center of the objects.

To Prepare Animation in OpenToonz

- Click on the first frame in the column (Col2) where the cloud is drawn.
- Select Animate tool from the Toolbox to give animation.

The software should set the position of the clouds in the other frames based on the position of the cloud in the first and last frames (keyframes). This is done using a technique called Position Tweening.

- Select Position from the animation option.
- In the first frame, adjust the position of the cloud on the canvas to where the movement begins.
- Now, the first frame has been set as a keyframe.
- Next, click on the sixtieth frame and adjust the position of the cloud on the canvas to where the movement ends.
- With this, the sixtieth frame has also become a keyframe. Our object is now ready for animation.
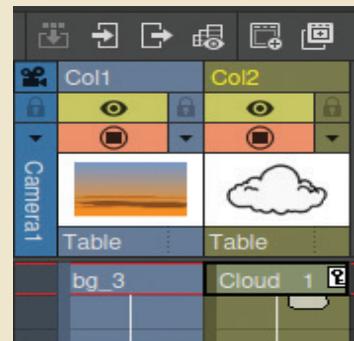
Fig. 8.11 when keyframe is set

The cloud animation has been created with the help of position tweening.

Press the Play button below the canvas. Does the animation work?
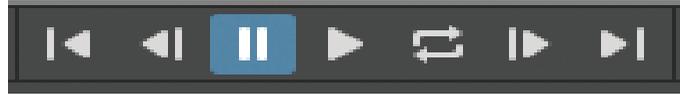
Fig. 8.12 Video Controls

Now, draw another cloud in a new column and give movement. Make the size of the cloud slightly different from the one you drew earlier...

We made the animation possible here by setting keyframes. Can we identify the frames that have been converted into keyframes from the columns in the Xsheet ?

Check the frames and find them.

Save the work using File - Save All. Files in OpenToonz are saved as project files with .tnz extension.

Let's Include Background Music

In movies, there are different ways to communicate effectively with the audience. The most important of these is the use of sound and music. Shall we include some of these elements too in our small animation movie.

A file named bg_music_1.mp3 is provided in the Animation/ Scene1 folder on your computer for background music in the first scene. Add this file to a new column (Col4) and check the animation of the first scene.

We need to use the same method to add sound as we did for the image in the first column. However, since the sound file included in the first scene will also appear in other frames according to its duration, we only need to repeat them if necessary.

Let's Make a Video

A small step of including background music in our first scene has been completed.

Now it is saved as a project file of the OpenToonz software on the computer. We can see the animation only if we open it in the software used to create it.

The tasks your are doing may be saved accordingly

If we export (render) the prepared animation as a video file, we can run it on the computer and mobile phone without the help of the OpenToonz software. We have been familiar with this method when we made projects in video-audio editing software also.

Use the Render option in OpenToonz to prepare our animation in mp4 video and save it in your folder.

To Render Video in OpenToonz

▪ From the Menu Bar ഒല Render → Fast Render to MP4.

▪ The video will be saved as MP4 after rendering.
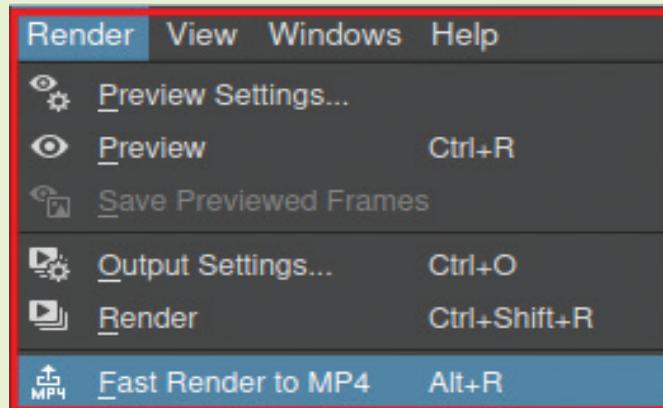
Fig. 8.13 Render Window

Animation Using Image Sequences

We have completed all the tasks of the first scene according to the storyboard. With this, we have become familiar with creating animation using images.

OpenToonz has the facility to create animation using image sequences instead of images also. For this, we need to prepare image sequences in advance. Preparing and using image sequences that contain the characters to enable subtle expressions and movements will make the animation work in OpenToonz easier. Even if the scenes are to be reused, their image sequences are more convenient.

Have you completed the storyboards for the other scenes of the animation you are going to prepare?

Below is the second scene of the storyboard prepared by Daya and her friends based on Luna's story. Let's prepare it with the help of the image sequences..

Scene	Background / Characters	Action	Dialogue	Music	Time	Remarks
Scene 2	Water, plant, Luna	Luna brings water from the puddle close to the plant		Background music	5 second	

Table 8.3 Luna –Storyboard Model (Scene 2)

See the Storyboard. We have to show Luna bringing water from the puddle to the plant. What images are needed to prepare this ?

For this, background image including the plant, image of puddle and the image sequence of the motion of Luna are given in Animation/Scene_2 folder.

While Including Image Sequence

When image sequences are added, we can see that the images have been inserted into as many frames as there are images in the sequence. These images can be inserted into other frames using the Repeat option.
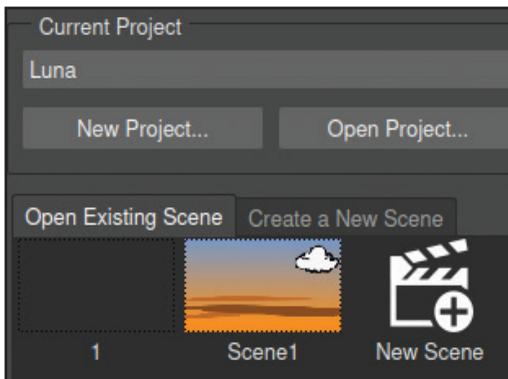
Fig. 8.14 Current Project

We shall prepare the second scene using the images from Scene_2 folder and image sequence from Scene_2/ Sequence folder.

The second scene can can prepared in the same way as we have completed the first scene.

If the OpenToonz have been closed, open it again and ensure that the current project is Luna in the Startup window (Fig 8.14)

- Click on the New Scene icon to begin the new scene.
- Give the name as Scene2
- Give the Camera Size, Units, Frame Rate same as the first scene.

Now, complete the second scene as per the storyboard.

- Include the background image in the first column and the image of water in the second column.

- Include the image of background and water into all the frames using (Repeat).

- Include the image sequence to the first frame in the third column.

Image sequence is to be added in the same way as image is added. But here, as many frames as the number of images in the sequence will be formed instead of one frame.

While Preparing Image Sequences

The file names of the images should be given as in a pattern while preparing image sequences to include in OpenToonz. Let's check the image sequence provided in the Sequence folder. When including such image sequences in the scene, only the common name in the image file name will be displayed in the Browser Room of OpenToonz.

For example, when including an image sequence with names luna _01.png, luna_02.png, luna_03.png, ... only its common name, luna_.png will be displayed in the Load level window. The number of image frames included in the image sequence can be seen in the Frames section.

Name		Type	Frames	Size	Date Created	Date
..		<DIR>			Tuesday, 2~:45 PM IST	Tu
luna_.png		PNG	9	752 KB	Tuesday, 2~:45 PM IST	Tu
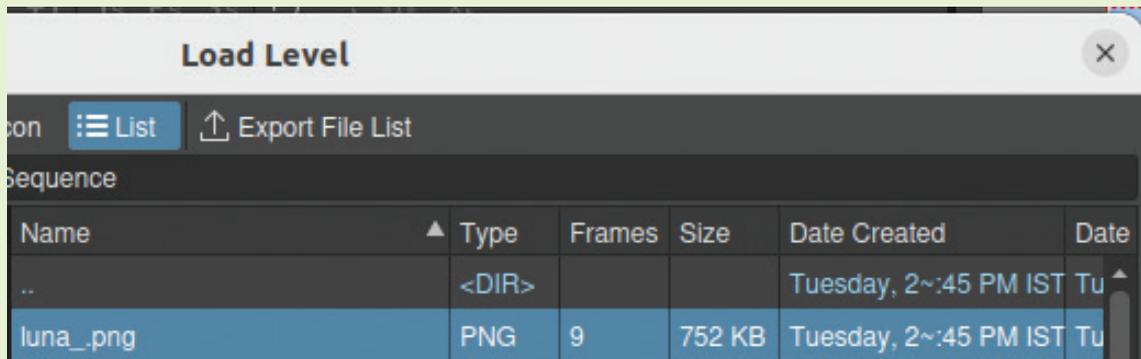
Fig. 8.15 Load Level Window

So, image sequence has been added to the first frame of the third column.

The scene in the sequence shows stagnant water being carried by Luna through the channel towards the plant. This scene will be complete only if this sequence is included in the remaining frames as well.

Use the note below to include the sequence of images in all frames.

To Insert the Image Sequence into Frames

- Click on the frame containing the first image in the sequence.
- Press and hold the Shift button and click on the frame containing the last image in the sequence
- Then, use Click and drag to repeat selected cells to insert the image into the entire frame
- Play the animation using the Play Button.

Animation Opportunities

Animation is widely used today in various fields such as film, advertising, industry, education, healthcare, gaming, etc. It is desirable for animation designers to have expertise in more than one field along with technical expertise. Animation is also a great career field today.

Have you tried running the animation with the image sequence included?

Is the animation of Luna directing the stagnant water, in the correct form now?

Use the Animate tool to adjust the size and position of the image of water in the second column and the position and size of Luna in the image sequence and then play the animation.

You can make the scene more attractive by adding background sound to the scene and an animation of a cloud moving in another column.

Once all the activities are completed, don't forget to render and save the animation video in your folder.

Let's Combine Scenes

The next step is to combine the animation scenes we have prepared into a small animated movie. For this, you can use any video editing software available on Kite GNU Linux.

You may use the Kdenlive software, which you have learned in the previous class. Don't forget to add title slides while preparing the movie.

If you need to make any changes to the prepared scenes, just open the previously saved project file (.tnz), make the necessary changes, and then render the video.

📖 Let us Assess

- The names of some rooms (workspaces) in OpenToonz software are given. Note down their uses.

Name of the Room	Use
Animation	
Drawing	
Browser	

- Given below are the icons of some important tools in OpenToonz. Complete the table with their uses.

Tool	Use

📖 Extended Activity

1. Create the third scene of the animated film Luna using OpenToonz. Combine this with the first and second scenes you created earlier and make a complete film. (Resources for creating the animation are in the folder Animation/Scene_3).

2. Create an animated film to be shown on World Anti-Drug Day based on the slogan "Say No to Drugs". Create the necessary images in Inkscape or GIMP.

❖ ❖ ❖

Chapter 9
To the Information Storehouse

You might see various kinds of information about the match, the players, and the venue being displayed on television during the live telecast of sports events. Have you ever wondered how such interesting and contextual information becomes instantly available during the game?

All this information related to the matches is made available to us with the help of a pre-collected and stored database system.

Knowingly or unknowingly, database has a major influence on our lives. A few examples are given below. Complete the ones that are incomplete:.

▪ Election results and related details displayed on television.

▪ Exam results and their analysis made available on websites.

▪ ....

▪ ....

▪ ....

You have learned in the previous class that spreadsheet software can be used to store and analyze information in tables.

Let's Find the Information in the List

Look at Figure 9.1. The table has been prepared in LibreOffice Calc with some information related to the Cricket World Cup.
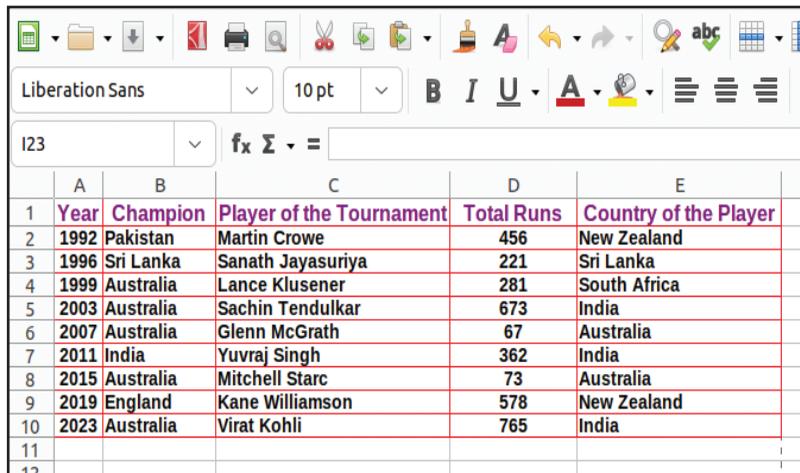
	Year	Champion	Player of the Tournament	Total Runs	Country of the Player
1	Year	Champion	Player of the Tournament	Total Runs	Country of the Player
2	1992	Pakistan	Martin Crowe	456	New Zealand
3	1996	Sri Lanka	Sanath Jayasuriya	221	Sri Lanka
4	1999	Australia	Lance Klusener	281	South Africa
5	2003	Australia	Sachin Tendulkar	673	India
6	2007	Australia	Glenn McGrath	67	Australia
7	2011	India	Yuvraj Singh	362	India
8	2015	Australia	Mitchell Starc	73	Australia
9	2019	England	Kane Williamson	578	New Zealand
10	2023	Australia	Virat Kohli	765	India

Fig. 9.1 Table Prepared in LibreOffice Calc

Can you find the answers to the following questions from this table?

- Which country won the Cricket World Cup in 2003?
  - ➤ The best player in the tournament
  - ➤ His country
- How many times has the player from the country that won the Cricket World Cup been the best player in that tournament?

What information will be there in the football World Cup table?

All this information can be made available very quickly on examining the data in the table given above. Here, we need to examine only a few data. But if we examine the data of all the cricket matches played since the first official cricket test between England and Australia in 1877, is it easy to examine and find the information of thousands of matches and as many players from one table?

Try to find out the answer of the following question too from the figure 9.1

▪ Which New Zealanders have been the tournament's best players?

Martin Crowe, Kane Williamson etc., right?

Information from Different Lists

Look at the information in the spreadsheet mentioned above, recorded in another form as tables.

Country Table

Country_ID	Country_Name
C100	Pakistan
C101	Sri Lanka
C102	India
C103	Australia
C104	New Zealand
C105	South Africa
C106	England

Table 9.1 Details of the country

Player Table

Player_ID	Player_Name	Total_Runs	Country_ID
P5001	Sanath Jayasurya	221	C101
P5002	Sachin Tendulkar	673	C102
P5003	Lance Clusener	281	C105
P5004	Martin Crowe	456	C104
P5005	Glenn McGrath	67	C103
P5006	Yuvaraj Singh	362	C102
P5007	Mitchel Starc	73	C103
P5008	Kane Williamson	578	C104
P5009	Virat Kohli	765	C102

Table 9.1 Details of the players

Matches Table

Year	Winner	Best Player
1992	C100	P5004
1996	C101	P5001
1999	C103	P5003
2003	C103	P5002
2007	C103	P5005
2011	C102	P5006
2015	C103	P5007
2019	C106	P5008
2023	C103	P5009

Table 9.1 Details of the Matches

Have you examined all the tables?

Are the answers to the questions we discussed earlier available from these tables?

For that, we will have to relate the three tables and examine them, right?

From these new tables, is it possible to find out from which country is the best player of 2011 World Cup?

How could you arrive at this answer?

- In the new tables, a special indicator (ID) has been given to the country, players, winner, and best player. Based on this,

  - We can find the ID of the best player in the 2011 World Cup from the Matches Table. This ID is P5006.

  - We can understand from the Player Table that the ID P5006 belongs to the player Yuvraj Singh.

  - We can find out from the Player Table itself that Yuvraj Singh's Country_ID is C102.

  - It is given in the Country Table that C102 is the Country_ID of India.

That is, the best player in the 2011 World Cup is an Indian.

Thus, all the information in the Calc sheet shown at the beginning of the lesson can be found by relating these three tables.

Is there any advantage in organizing the information in different tables like this?

- The same information is not recorded repeatedly in these tables.

- All the information related to a subject is put in one table here. You can understand their contents from the names of these tables. For example, Country, Player, etc.

Is it dificult to collect information from more than one source?

To the Database Management System

Finding information from multiple tables by relating them is not as easy as finding information from one table.

But what if we had computer software that could help us find and provide the information we need from such interconnected

tables? Such software is called Database Management Systems (DBMS).

DBMSs not only provide us with the recorded information in the way we need, but also help us store it, make changes to it, and eliminate unnecessary ones. It is with the help of such software that we can display and analyze large amounts of collected information very quickly today.

DBMS Software

The information stored in DBMSs is presented to the user in an easy and attractive manner with the help of techniques like html,, Java, Python, etc. Important DBMS softwares are Oracle, MySQL, SQL Server, and sqlite.

DATABASE

We have examined the information from the tables related to the Cricket World Cup here. A database is a collection of tables in which such interrelated information are recorded in a systematic manner.

We can prepare a database by including information in this table in a DBMS software.

Suppose that we used a database named cricket_worldcup and its tables Country and Player to find the answers to the questions. We shall now prepare a database of this type and its tables.

Fig. 9.2 Tables of the Cricket_worldcup Database

See the tables 9.1 to 9.3. There are many rows and columns in each one of these tables. What are the columns in the table Player ?

- Player_ID

- Player_Name

- Total_Runs

- Country_ID

These are called Fields of the table in relation to Databases (Fig 9.3)

Player Table

Fields

Player_ID	Player_Name	Total_Runs	Country_ID
P5001	Sanath Jayasurya	221	C101
P5002	Sachin Tendulkar	673	C102
P5003	Lance Clusener	281	C105
P5004	Martin Crowe	456	C104
P5005	Glenn McGrath	67	C103

Fig. 9.3 Fields of the Table

Similarly, note down the fields of the other tables (9.1, 9.3)

- Country : ....

- Matches : ....

The information collected in each field of the table is different. The names of the players contain letters whereas the field of Total_Runs will be numbers, right? That is, the information collected in each field will be composed of different Datatypes.

Observe the table given below.

Which tables will be needed to analyse the test results?

Sl. No.	Fields	Datatype
1	ID of the country	Text
2	Year of game	Number
3	Date of game	Date
4	Picture of the player	Image

Table 9.4 Some Datatypes

You have seen some common datatypes. Apart from these, Audio and Video are also datatypes. But they are known by different names in each DBMS.

Details about the player is given in rows. These rows in the table are referred to as Records (Figure 9.4). All the information collected about a player can be found in a record in the Player table.

Records

Player Table			
Player_ID	**Player_Name**	**Total_Runs**	**Country_ID**
P5001	Sanath Jayasurya	221	C101
P5002	Sachin Tendulkar	673	C102
P5003	Lance Clusener	281	C105
P5004	Martin Crowe	456	C104
P5005	Glenn McGrath	67	C103

Fig. 9.4 Records in the Table

In the Case of the Same Data

Look at Figure 9.3. Why is the field Player_ID included in this table?

Suppose there are more than one children with the same name in your class. Do you know what is used to identify such children with same name in the records related to the class?

- Their Roll No will be different, right?

Similarly, accurate data can be obtained only if we are able to distinguish each record in a table from the other records.

Thus, the fields added to identify each record in each table from others are called Primary key (Figure 9.5).

Primary Key

Player Table			
Player_ID	**Player_Name**	**Total_Runs**	**Country_ID**
P5001	Sanath Jayasurya	221	C101
P5002	Sachin Tendulkar	673	C102
P5003	Lance Clusener	281	C105
P5004	Martin Crowe	456	C104
P5005	Glenn McGrath	67	C103

Fig. 9.5 Primary Key in the Table

Some other such cases where one record is added to distinguish one from another while storing information are given below. Try to add similar ones.

- Admission Number is given to students.

- Book code is given to books in the school library.

- School Code is given to all schools.

- ....

- ....

- ....

Let's Create a Database for the Cricket World Cup

We have already learned some things about database management systems. Let's see how to create a database containing information related to Cricket_worldcup matches using these. We shall do this using SQLite, a DBMS that belongs to the free software category.

Open the software DB Browser for SQLite on your computer and create a database with Cricket_worldcup as file name and save it in your folder.

To Prepare Database Using Sqlite

- Open DB Browser for SQLite on your computer.

- Click on New Database to create a new database (fig 9.6)

- Give the name of the Database (Cricket_worldcup) against Name in the window that opens.

- Then, select the folder to which you want to save and click Save.
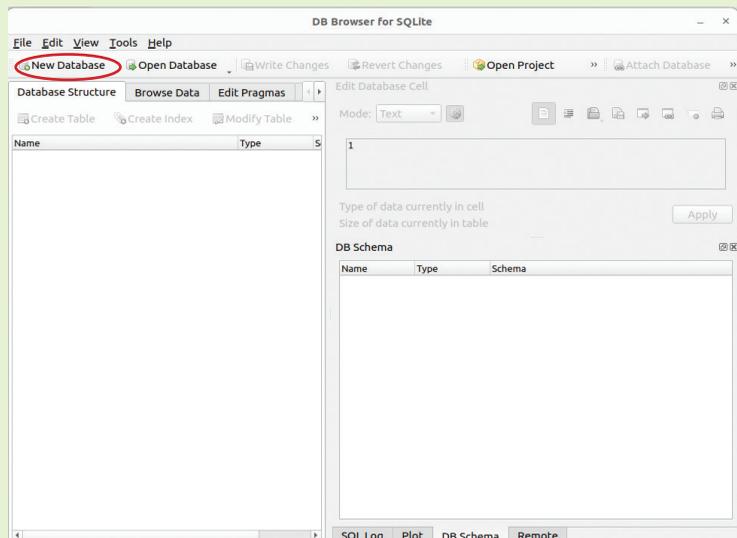

Fig. 9.6 DB Browser for SQLite Window

Thus, the window for creating table will be displayed. le creation window. We have to create our tables here.

Shall we prepare the table Country first?

To Prepare Table in DB Browser for SQLite

- Give the name of the table (Country) against Table in the Edit table definition window.

- Then, click on the Add button below.

- Edit the name of the field as Field1 against Name.

- Add other fields in the same way.

Sqlite

Sqlite is a DBMS that is completely a free software. This system can be used in desktop software, mobile apps, and web applications. In Sqlite, the database is stored as a single file on disk. Therefore, the database can be easily managed and configured.

Sqlite was developed by D.Richard Hipp, a software engineer.
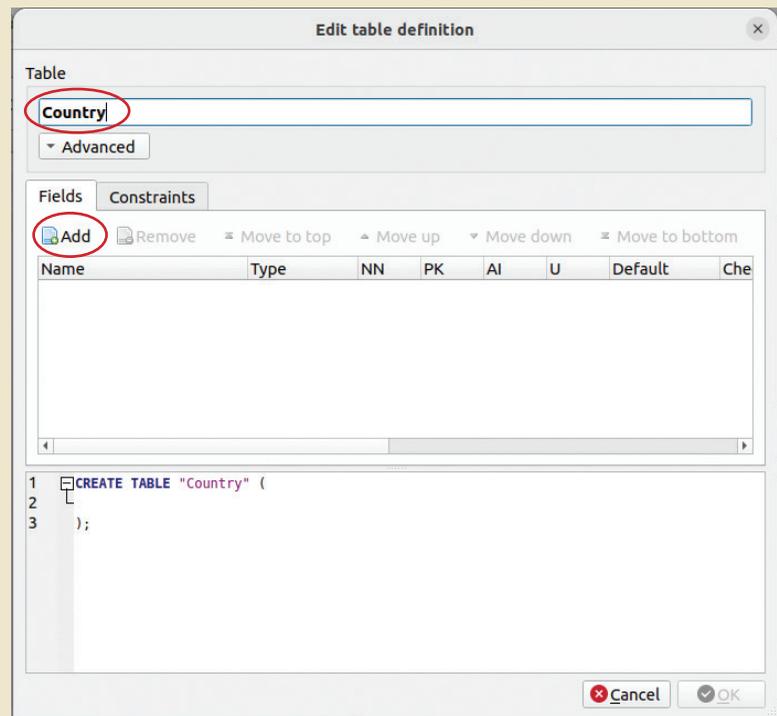
Fig. 9.7 DB Browser for SQLite-Edit Table Definition Window

In the table Country, we need to add two fields - Country_ID and Country_Name. Once Country_ID is added, we can select its datatype.

Country_ID consists of letters and numbers, such as C100. So, guess what will be its datatype.

In our record, Country_ID is the field with a unique value used to identify it. Therefore, we can set Country_ID as the Primary Key.

To Set Primary Key in DB Browser for SQLite

- Click on the field which has to be set as the Primary Key
- Then, enable tick mark in PK.
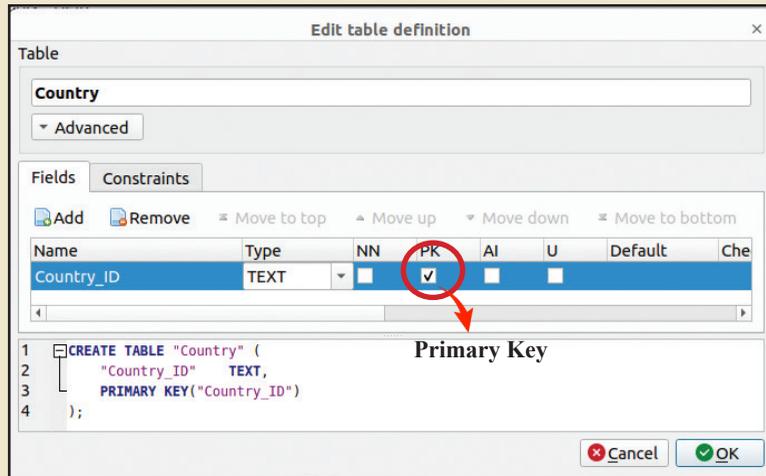
Fig. 9.8 How to set Primary Key in DB Browser for Sqite

- Click OK after including necessary fields.

Now, include the field Country_Name in the same way (Fig 9.9).
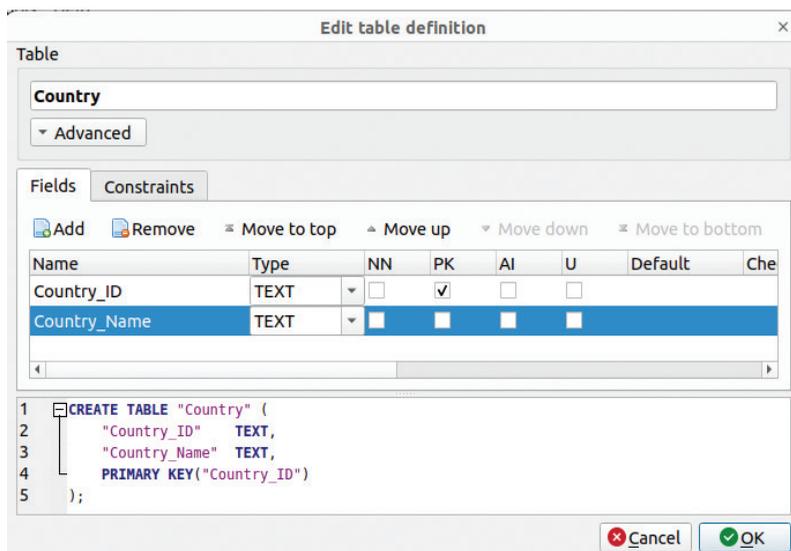
Fig. 9.9 Fields Included in Table

> What will be the primary key of the table - captains in the School Sports festival?

With this, you can see the table named Country under the Tables section of the main window (Figure 9.10).
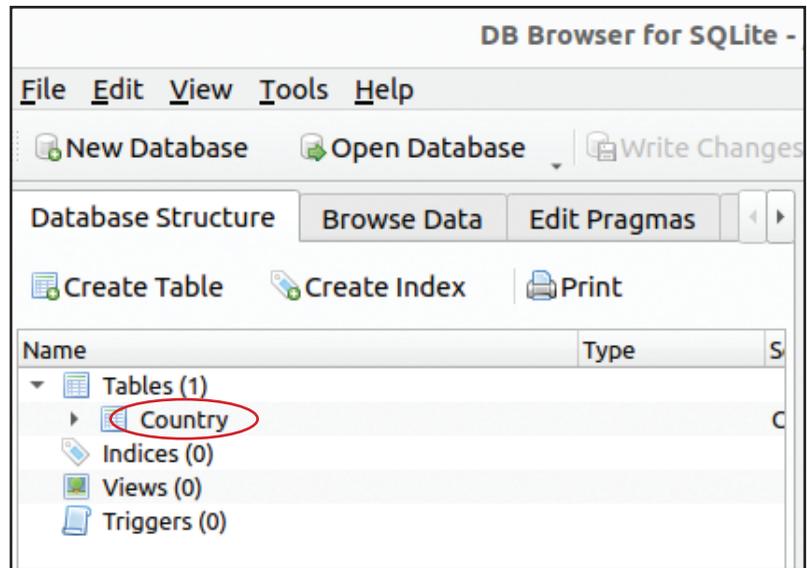
Fig. 9.10 DB Browser for SQLite – Database Structure window

Let's Add Information into Database

We have already created the required tables in the database related to the Cricket World Cup. Now we need to add information to these tables.

For this, Insert new record to current table option is available in the DB Browser for SQLite window.

To Add Records in DB Browser for SQLite

- Select the tab Browse Data in window.

- Select the table to which records are to be included. (Here we have created only Table, Country and so it will be selected)

- Then, click on the button Insert new record to current table.

- Now, add the records one by one by typing.
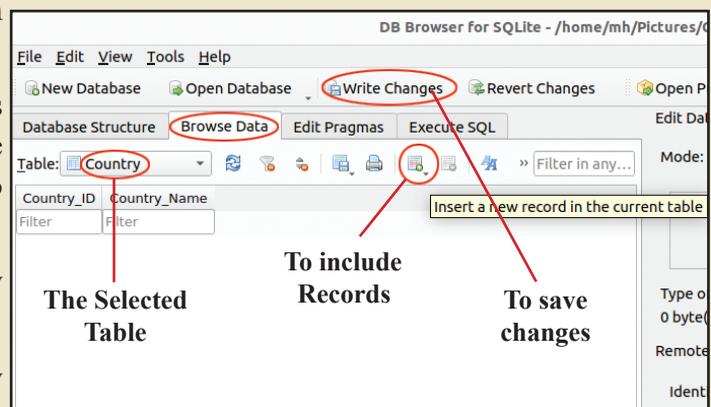
Fig 9.11 DB Browser for SQLite – Method to Add Records

In the table, Country that you have created, add the details from Table 9.1, one by one using the Insert new record to current table feature (Figure 9.12).

Fig. 9.12 Details Included in the Table Country

Similarly, prepare the tables – Player, Matches and include the details given in table 9.2 and 9.3 accordingly.

Fig. 9.13 Records Included in the Table Player

Discuss why INTEGER datatype has been given to the Total_Runs field of the table Player.

Let's Retrieve Information from the Database

We have created the tables required for the Cricket_Worldcup database and added various records to them. To view all the

records added to these tables, just click the Browse Data tab and select the table.

But how do we find only the information we need from this?

For example, suppose we want to find the number of runs Sachin Tendulkar has scored from this database.

There are only very few information about the players in Player table of the database we have created. So, we can open the table through the Browse Data tab and quickly find it. But if there are thousands of players in this table, is this task easy?

The way to do this is by using SQL Queries.

Notice the equivalent SQL queries are displayed when the table is created in the DB Browser (Figure 9.13).

So, to find the number of runs scored by Sachin Tendulkar from the Player table, simply enter the following query in the Execute SQL tab and run it (Figure 9.14).

'select Total_Runs from Player where Player_Name='Sachin Tendulkar'

Structured Query Language (SQL)

DBMSs communicate using a special computer language called Structured Query Language (SQL). It is a language that can be used very easily, like the English language. Not only can you select information from tables, but you can also create and modify tables, insert information into tables, edit and delete information.

In some DBMSs, these operations can only be performed using SQL.
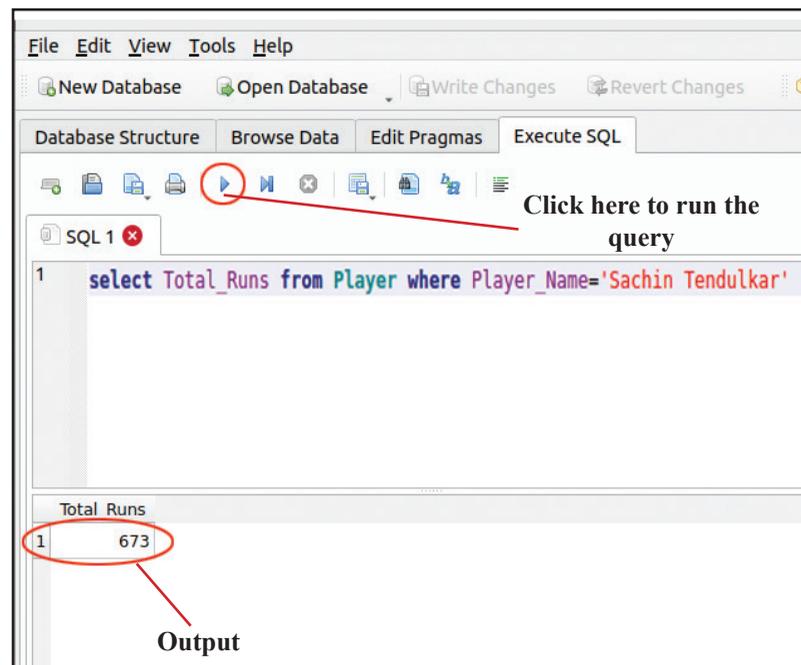
Fig. 9.14 Execute SQL Window

Now, write and run an SQL query to display the name of the player who scored 765 runs in the Player table.

- *select Player_Name from Player where Total_Runs=765*

More SQL Queries

Some SQL statements to retrieve information from the Player table are given below. Run them and complete the table.

	SQL Statement	Use
1	select Player_Name from Player where Total_Runs>300	to get the names of all the players who have scored more than 300 runs
2	select Player_Name from Player where Total_Runs between 200 and 400	
3	select Player_ID, Player_Name from Player where Country_ID='C103'	
4	select * from Player	to get all the details from the Player table
5	select Player_ID, Player_Name from Player where Country_ID in ('C103', 'C105')	
6		To get the names of the players who have scored less than 400 runs.

Table 9.5 Some SQL Statements and their Uses

Retrieving Data from Multiple Tables

We have now seen a few SQL queries that retrieve data from the Player table.

Now consider the query given below.

- Which country is the player 'Sanath Jayasuriya' from?

The Player table does not provide the country of each player. Instead, Country_ID is provided. To find the country with the given ID, we will have to examine multiple tables (including the Country_ID field in the Country table).

That is, here the field Country_ID in the Player table is used to find the relation with the Country table. Such fields are known as Foreign keys (Figure 9.15).

Fig. 9.15 When more than one Tables are Examined for Information

Here, note that a foreign key refers to the primary key of the table with which the relationship is established.

If so, what will be the SQL query to find out the nationality of 'Sanath Jayasurya' ?

We have discussed that this information will not be available from a single table. So,

- We get the Country_ID of Sanath Jayasurya as C101 if we give 0*Select Country_ID from Player where Player_Name='Sanath Jayasurya' as query.*

- We can know that the country with C101 as ID is Sri Lanka from the Country table. But if there are hundreds of countries in this table, this is not easy.

If so, what will be the query to find out the name of the country with C101 as ID from the Country table?

- *select Country_Name from Country where Country_ID='C101'*

Now, combine this statement with the former one -

- *select Country_Name from Country where Country_ID=(Select Country_ID from Player where Player_Name='Sanath Jayasurya')*

In the same way, try writing and running an SQL statement to find out which country the player Lance Clusener belongs to.

Let's Asses

♦ Which one is used to distinguish the records of a table from the others?

   a) primary key   b) foreign key   c) fields   d) private key

☐ SQL means ....?
   a) Systematic Query Language   b) Structured Query Language
   c) Structured Questions Language   d) Sequenced Query Language

Extended Activities

1. We have understood the need to control internet usage and screen time. Below is a table containing the data collected from a survey conducted among students regarding screen time.

   Create a database called Screen_Usage and prepare the tables as shown below.

App_ID	App_Name	App_Category	Usage_Duration (Minutes)
100	Samagra AI	Education	60
101	Facebook	Social Media	32
102	Youtube	Social Media	15
103	E-cube English	Education	25
104	G-Combris	Education	20
105	Whatsapp	Messaging	35
106	G-pay	Banking	10
107	Maps	Navigation	5

Now, try writing and executing the following SQL statements from the Apps table.

▪ Which all Educational Apps are made available?

▪ Which all Apps are being used more than 30 minutes in a day?

▪ To which category does the SAMAGRA AI App belong?

❖❖❖

Chapter 10

Software and Freedom

Until the 1980s, the development of computers and software was marked by collaboration and shared contributions. During this period of rapid technological growth, commercial interests were relatively minimal. However, in 1979, a popular word processing software called Scribe introduced a hidden, secret code in its program, marking the beginning of a new era. This software was designed with a "time bomb"—a piece of code that would render the program inoperable exactly 90 days after being copied and run on a system. The only way to reactivate it was for the user to pay the manufacturing company.

This incident caused a major uproar in the software development world at the time. Renowned computer programmer Richard Stallman famously criticized this practice, stating:

"This is the murder of programmers' ideals. Instead of upholding the principles of sharing and collaboration, we are now forced to bow to corporate demands—creating a system where knowledge must be paid for."

Richard Stallman

But times have changed. Business has become heavily monopolized, with profit-driven motives now dominating the field. Nevertheless, glimmers of hope remain—let us examine how.

Software and its Program

To create software, there are many programming languages like Python, C, Java, Rust, and more. We have already learned how to write small programs in Python.

The human - readable instructions (written in a programming language) that make up a program are called source code (see Figure 10.1). This source code can be edited based on the syntax rules of the programming language.

Before a computer can run a program, the source code is converted into a format that the machine can process. This converted form is called object code (or executable code). Unlike source code, object code cannot be easily modified.

Fig. 10.1 Source Code of a Python Program

Python and Source Code

The creators of the Python programming language included a key principle in its foundational guidelines (The Zen of Python): "Code should be written in a readable and clear manner." This is why Python programs are typically distributed as source code itself. When the program is executed using an interpreter, the source code is converted into object code on the fly.

Since programs distributed as source code it allows users to read, learn, and modify them, the software's license terms must explicitly specify the conditions under which changes to the source code are permitted.

However, there is another side to this. Suppose the source codes of software are made available for others to examine and study. What are the outcomes?

- Users can examine how the software works, allowing them to trust and confidently use the programs they rely on.

- Those who are interested can learn the program. Those who are skilled can make changes and improve it if necessary. Improved or unimproved versions can be distributed. This will allow knowledge to reach more people.

- Collaborative development leads to higher-quality software. The likelihood of bugs and vulnerabilities is reduced. This reduces the risk of computer viruses and malware.

- Software companies move away from sales monopolies and instead focus on efficiency and quality service.

- Since the software is not proprietary, companies using it can produce tools at lower costs, making technology more affordable.

- ....

Let's Check the Source Code

Keeping the above points in mind, let's analyze the source code of a small program:

The software Calculator.pyc written in Python, is given in the School Resources/Class_10 folder on your computer. Try running this file using python 3.

Observe the current button colours in the software (Figure 10.2). What if you want to change these colours to your preferred shades?

To Run the File Using Python3

- Open the terminal by right-clicking on the folder where the Python file is saved and selecting Open in Terminal.
- Type the command below in the terminal and press Enter.
  python3 filename (Ex: python3 Calculator.pyc)

For this, we need to make the necessary changes to the Calculator software program and update it. Since the file Calculator.pyc is the object code of the software, we cannot edit it. So, if we want to change the program, we need its source code. This is provided in the Source folder as a Python file called calculator.py .

Open this file, find the code that gives the colour to the buttons, change it to a different colour, and try running it.

What if you want to change the calculator's name from Tom to yours?

Software Publishing

Creating software is just the first step—it must also be published effectively for others to use. When releasing software, keep these points in mind:

1. The software should be made publicly available in a way that allows easy download and use.

2. If users are permitted to read, modify, and redistribute the software, its source code must also be published. The terms for modification and redistribution should be clearly stated in an easy-to-understand manner.

3. Allow the software to be improved (upgraded) or forked (modified into new versions). Different versions should be organized sequentially for clarity.

4. Clearly define the license conditions for any modified versions of the software.

Fig. :10.2 Calculator Software Prepared in Python

There are several services available that incorporate all the above possibilities and help publish software online. Below are some of them:

- GitLab (https://about.gitlab.com)
- GNU Savannah (https://savannah.gnu.org)
- Gitea (https://about.gitea.com)
- GitHub (https://github.com)
- SourceForge (https://sourceforge.net)

When publishing the developed software, the terms and conditions we specify must be formalized into a legally valid one. Since it is difficult to legally register the terms when we prepare them ourselves, we can opt for pre-existing standardized licenses prepared by established organizations.

A software license defines the rights granted to users regarding how the software may be used. Below are some software licenses:

- GNU Public Licence
- BSD (Berkeley Software Distribution) licence
- End-User Licence Agreement (EULA)

These all provide different usage rights to the user. See Table 10.1 below.

	Rights granted	Various licenses		
		GPL	Apache	EULA
0	for the user to use for any purpose.	provides	provides	No
1	reading and learning source code	provides	provides	No
	copying and editing as needed	provides	provides	No
2	To distribute copies of the software and to provide follow-up services using them	provides	provides	No
3	To redistribute modified or unmodified versions	Provides on condition	provides	No
A	To obtain another license for the modified parts	No	provides	No
B	To distribute together with other software with different licenses (Software package)	No	provides	No

Table 10.1 License Usage Rights

Beyond the previously mentioned licenses, there exist other licenses that either grant additional rights or impose further restrictions. See the following examples.

- The source code can be distributed with or without modifications. However, you must ensure that the original license applies to any modifications or additions. Such software can be called free software. These can only be used by combining them with other free software, such as the GPL (General Public License) published by GNU. GIMP is software distributed under this license.

- Software can be modified and redistributed, and the programmer can decide the terms of distribution of (only) the combined parts. There is no problem distributing it as a single package with other non-free software. These are generally called open source licenses. There are several open source licenses that vary in detail. The Apache License, which distributes the Android operating system, is an open source license. The Berkeley Software Distribution (BSD) License is an example.

- As mentioned, there are software that only provides object code. Some of them can be installed on any system. Some can be used indefinitely. Some software is also distributed for free. These fall into the category of freeware

- Some of the above types can only be used for a limited time (Testware). These do not grant any other rights.

- Software that provides only object code will have usage restrictions, allowing it to run only on a registered, specific system. Even if you have another computer, a new license must be obtained for it. Operating systems like Microsoft Windows and Apple iOS fall under this category.

It appears that a separate license is needed for each computer when we use proprietory O.S.

In essence, free software prioritizes principles such as user freedom, the dissemination of knowledge, ethics, justice, and public good. Most free software is developed through voluntary efforts and is available free of charge.

Open-source software, on the other hand, emphasizes universal accessibility, collaboration, usability, improvement, and innovation. A middle-ground approach has emerged in the form of FLOSS (Free/Libre and Open Source Software) licenses.

(The English word 'Free' in this context refers to 'freedom' rather than just 'zero cost.' Such licenses emphasize that the software must be free—as in liberty—not necessarily free of charge.)

Versions and Forks

Any software in use undergoes periodic updates over time. The purpose of creating a new version is to rewrite the security code of the program, improve existing features, add new functionalities, etc. Software versions are typically indicated by a numbering system. For example, Kazium Version 21.12.3 means the 21st major version of the Kazium software, the 12th interim improvement, and the third minor changes (patches).

Fork is applicable only in open/free software. Those who disagree with the views, methods, or features of existing software - rewrite and distribute the software source code as permitted by the software's license. For example, the two forks we use, LibreOffice (published by The Document Foundation) and Apache OpenOffice (published by the Apache Software Foundation), are two forks of the defunct OpenOffice software.

Let's Check the Licenses

As mentioned earlier, the GNU General Public License (GPL) falls under the first category of free software licenses. The key terms of this license (listed as items 0, 1, 2, and 3 in Table 10.1) should be noted separately in your notebook. These terms define the essential conditions for free software.

Why is the First Term Numbered '0'?

Check Software Licenses on your Computer as given below.

To Check Licenses

To check the license of the Krita software on our operating system,

- Open the software window and check the Help menu in the menu bar.

- When you click About Krita, check the License item in the window that appears.

- It should be noted that Krita is distributed under the GPL license.

Mozilla Firefox, the web browser we use on our computers, is licensed under the Mozilla Public License. This is a FLOSS license. See Figure 10.3 below.

About Your Rights

Mozilla Firefox is free and open source software, built by a community of thousands from all over the world. There are a few things you should know:

- Firefox is made available to you under the terms of the Mozilla Public License. This means you may use, copy and distribute Firefox to others. You are also welcome to modify the source code of Firefox as you want to meet your needs. The Mozilla Public License also gives you the right to distribute your modified versions.
- You are not granted any trademark rights or licenses to the trademarks of the Mozilla Foundation or any party, including without limitation the Firefox name or logo. Additional information on trademarks may be found here.

Fig. 10.3 License of Mozilla Firefox

Complete Table 10.2 by identifying the licenses for the software we use for various purposes. Check on the internet if needed.

Software	License	Category	Special Terms
LibreOffice	Mozilla Public Licence	FLOSS	Trademarks used in the software may not be freely used.
Scratch			
Firefox			
Chromium			
GeoGebra			

Table 10.2 Details of Software Licenses

History of Licenses

As we know, progress in the world has always been built upon prior knowledge and discoveries. By the 1980s, a debate emerged that software source code—like literary works such as stories and poems—should be recognized as original intellectual creations. This idea gained legal acceptance first in the United States and later in other countries, bringing program source code under

copyright law. As a result, reusing a program's code or parts without permission became legally equivalent to plagiarism or literary theft.

A programmer's work must be protected from being stolen by others. This is society's responsibility towards that individual. However, this led to the hiding of program codes and attempts to establish monopolies in software. To address this, software licenses came into use, some of which strongly oppose the free dissemination of knowledge..

Free Software Foundation

Along with the aforementioned commercialization, there were indeed strong counter-movements. One such pioneering initiative was the GNU Project, established in 1983 by renowned computer programmer Richard Stallman. The primary objective of this project was to create and make freely available software that could be used with complete freedom. To support these efforts, the Free Software Foundation (FSF) was formed to create and improve software for the GNU Project, a non-profit organization of volunteer programmers that began in 1985. Today, the organization has branches and many activists around the world.

Unix Operating System

Developed during 1969–70 under the leadership of Ken Thompson, Dennis Ritchie, and Douglas McIlroy at AT&T (one of the world's largest telecom and software companies at the time), Unix became a foundational operating system. Its development began in 1969, and later, its ownership rights were transferred to various other companies. These versions, after significant changes and additions, have been used in the operating systems of Apple Corporation (Mac OS X) and the University of California, Berkeley (BSD - Berkeley Software Distribution). Many of today's operating systems are developed from Unix or have been rebuilt based on Unix.

The GNU Project and Its Software

The GNU Project, founded by Richard Stallman, attracted programmers from around the world who contributed without profit motives, creating nearly all essential free software components.

GNU (GNU is not Unix)

When Richard Stallman called on the programming community around the world to create a new operating system, hundreds of programmers came forward to collaborate with the GNU Project. Most of them worked for various other organizations. But Stallman was unable to bring them together or explain the project at the time.

GNU is not Unix

With these constraints, the practical approach was to create a new system modeled after an existing one. Therefore, Stallman asked for the Unix operating system to be used as a model in this regard. Everything that was in Unix should be included in the new operating system. But it was imperative that none of the Unix program codes be used. Then, the programmers who collaborated on the project rewrote Unix, without copying the codes. This is what the name GNU (GNU is not Unix) refers to.
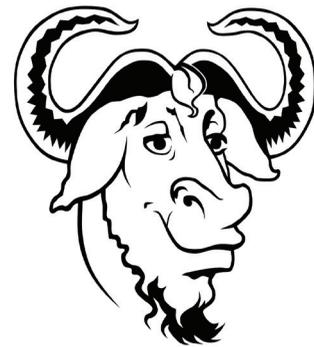
Copy Left

If a software developer wishes to grant users the freedom to use, copy, modify, and redistribute a program, these rights must be legally guaranteed. Copyleft is a licensing method that uses copyright law itself to ensure that all users retain these freedoms.

Copyleft does not mean that the software is unregistered or unprotected by copyright law. Rather, it means that the rights have been formally registered and granted to the user under specific terms that ensure freedom.

The GNU Project and Linux

An operating system has two main parts at the functional level. One part is called the Kernel and the other part is called the Shell. The kernel is the part that directly interacts with the computer's hardware. The shell is the part that interacts with the user. The graphical user interface (GUI) part of the operating system, which consists of software windows, is associated with the shell (Figure 10.4).

to build was called The Hurd. However, even after all the other software of GNU was completed, the Hurd was not completed. Around the same time, a Finnish programmer named Linus Torvalds completed and published a kernel program called Linux. Torvalds, who had listened to Stallman's requests for GNU, built the new kernel in such a way that it could run the software that the GNU Project was developing. The combination of these two was the GNU/Linux operating system that we use today.

The kernel and other parts of the GNU/Linux operating system we currently use are given below.
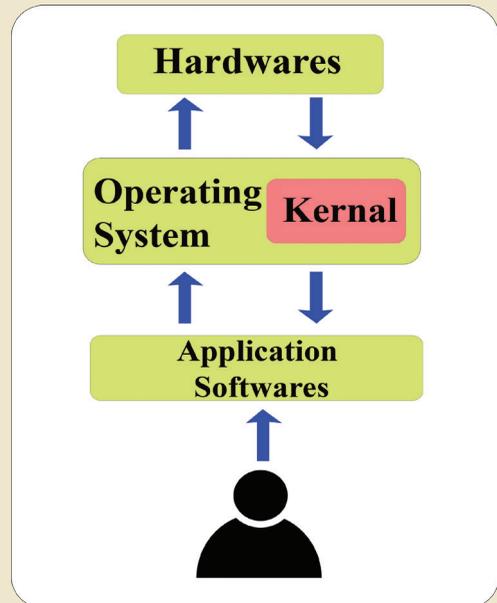
Fig.:10.4 Operating system – working phase

Kernel	Linux
Shell	GNU Bash (GNU Bourne Again Shell)

The term "Shell" originates from the Unix operating system. When examining how GNU developed its version, the name "Bash (GNU Bourne Again Shell)" is highly meaningful.

Free Software Development

You may have heard of the Microsoft Windows operating system. Microsoft, a proprietary software company, employs its own programmers to develop and improve Windows.

However, free and open-source software (FOSS) is not developed this way. Instead, it follows a different approach, as described below.

- Publishing the concept, methods, and features of a software on the Internet.

- A prototype of it is being published.

- Any user from any corner of the world can participate in the subsequent activities. They can discuss ideas, add program codes and can correct mistakes.

What Infrastructure is Needed for This Approach?

- Many contributors will create multiple versions of the software. These versions must be properly stored and managed.

- Each version should indicate which parts of the source code have been modified and which changes have been proposed.

- If major changes cause issues, developers should be able to roll back to a previous version. Hence, every version must be preserved.

- ....

Git is an online software that handles all of the above needs. It is a system created by Linus Torvalds, the creator of the Linux kernel (Figure 10.5), for the collaborative improvement of his software. Apache Subversion, developed by the Apache Software Foundation, is a software for centralized improvement.

GitHub, GitLab, GNU Savannah are popular platforms that rely on such version control software for publishing and managing code.

GNU-Linux Distributions

We have discussed that GNU-Linux is licensed in a way that allows anyone to copy, modify, and redistribute it. Taking advantage of this opportunity many versions of GNU-Linux programs have been created. These distributions vary widely based on the developers' vision and the specific needs they aim to fulfill.

Fig. 10.5 Linus Torvalds

Cathedral Model and Bazaar Model

Have you noticed the ways Microsoft and Linux build software?

Eric Raymond, a famous writer on technology, called this the Cathedral Model and the Bazaar Model.
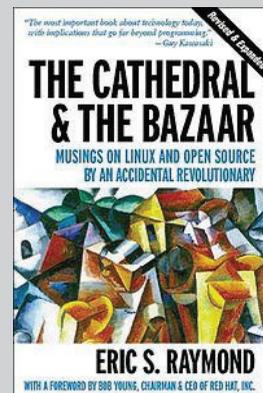
Some GNU-Linux Distributions

- Debian GNU/Linux (from which there are many versions, such as Ubuntu and the Kite GNU-Linux we use).

- Red Hat Linux

- Slackware Linux

(There are many other versions of each of these.)
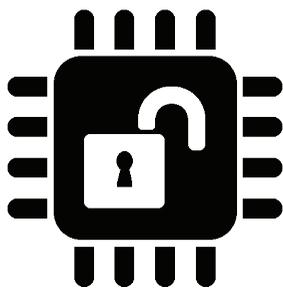
Android

Android is a widely used operating system in touchscreen mobile phones, tablets, and other devices. It is based on the Linux kernel, and its program code is available under an open-source license.

Android is a prime example of how free and open-source software (FOSS) benefits society. By using Android, manufacturers can produce smart devices like mobile phones and sell them at lower prices, as they don't have to invest heavily in developing their own operating systems.

Open Hardware

It's not just software that is being monopolized. The technology behind computers, other electronic devices, and mechanical components is also being monopolized in this way.

These are the following stages in the manufacturing of an electronic device.

- Outline of the general organization of machine , illustrations, diagrams, etc. that help in the construction of components

- Required component structures and their manufacturing methods

- Layout diagrams of electronic chips

- Special software (drivers) for the operation of components

- ....

If the above-mentioned [technologies/components] are obtained, any company with the technical capabilities to manufacture electronic devices can produce them.

Conventionally, large corporations invest significant capital in research and development to create specialized equipment, but they rarely publish their manufacturing methods.

However, just as we saw earlier with free and open-source software, there is now a growing open-design movement for hardware components released under free manufacturing licenses.

An example of this is the Arduino microcontrollers (Figure 10.6), which are widely used in schools and follow open-hardware principles.

Fig. 10.6 Arduino Uno board

Let's Evaluate

* Which of the following is not an open source software license?

    a) Apache Software License

    b) End User License Agreement

    c) GNU General Public License

* Which of the following is free hardware?

    a) Apple mobile phones

    b) Arduino similar chipset

    c) Mobile phones with Android installed

* What is the name given to free software?

    a) Free software

    b) Open software

    c) Freeware

* What is the shell in the GNU/Linux operating system known as?

    a) Open Shell

    b) Linux Shell

    c) Bash

* Which of the following is not an operating system?

    a) Android

    b) Linux

    c) Unix

Extended Activities

1. Complete the table below by searching familiar operating systems on the internet.

Operating system	Based program	The device used
Ubuntu	Linux	Computer
iOS	Unix	
Android	Linux	mobile phone,.....

2. Search the internet for the names of operating systems used in wearable devices such as smartwatches and VR headsets, and make a list.

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Notes

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CONSTITUTION OF INDIA

Part IV A
FUNDAMENTAL DUTIES OF CITIZENS

ARTICLE 51 A
Fundamental Duties - It shall be the duty of every citizen of India

a) to abide by the Constitution and respect its ideals and institutions,the National Flag and the National Anthem;

(b) to cherish and follow the noble ideals which inspired our national struggle for freedom;

(c) to uphold and protect the sovereignty, unity and integrity of India;

(d) to defend the country and render national service when called upon to do so;

(e) to promote harmony and the spirit of common brotherhood amongst all the people of India transcending religious, linguistic and regional or sectional diversities; to renounce practices derogatory to the dignity of women;

(f) to value and preserve the rich heritage of our composite culture;

(g) to protect and improve the natural environment including forests, lakes, rivers, wild life and to have compassion for living creatures;

(h) to develop the scientific temper, humanism and the spirit of inquiry and reform;

(i) to safeguard public property and to abjure violence;

(j) to strive towards excellence in all spheres of individual and collective activity so that the nation constantly rises to higher levels of endeavour and achievements;

(k) who is a parent or guardian to provide opportunities for education to his child or, as the case may be, ward between age of six and fourteen years.

CHILDREN'S RIGHTS

Dear Children,

Wouldn't you like to know about your rights? Awareness about your rights will inspire and motivate you to ensure your protection and participation, thereby making social justice a reality. You may know that a commission for child rights is functioning in our state called the Kerala State Commission for Protection of Child Rights.

Let's see what your rights are:

- Right to freedom of speech and expression.

- Right to life and liberty.

- Right to maximum survival and development.

- Right to be respected and accepted regardless of caste, creed and colour.

- Right to protection and care against physical, mental and sexual abuse.

- Right to participation.

- Protection from child labour and hazardous work.

- Protection against child marriage.

- Right to know one's culture and live accordingly.

- Protection against neglect.

- Right to free and compulsory education.

- Right to learn, rest and leisure.

- Right to parental and societal care, and protection.

Major Responsibilities

- Protect school and public facilities.

- Observe punctuality in learning and activities of the school.

- Accept and respect school authorities, teachers, parents and fellow students.

- Readiness to accept and respect others regardless of caste, creed or colour.