

INTRODUCTION TO SCRATCH



SCRATCH



- ◆ Explain scope, possibilities and limitations of scratch.
- ◆ Demonstrate downloading and installation process of Scratch Editor OR Working with Scratch Online.

7.1 SCRATCH

Since the emergence of FORTRAN in 1950s, computer languages have evolved enormously. Programming languages are used to create instructions for computers. Using these limited instructions, we can instruct the computer to perform a desired activity. Nowadays, programming languages have become very user-friendly and easy to learn and program. Now, there are some visual languages which do not require memorizing of code syntaxes. Instead, a program is developed by simply dragging and dropping some components of that language and entering their values.

Scratch is one of such programming languages. It is very easy to create programs in Scratch which include games and animations. Interactive stories, games, animation, music, art, and presentations can be created by simply dragging and dropping colored blocks. This programming tool was developed by Massachusetts Institute of Technology-(MIT) Media Lab. Scratch is free to use and distribute and will remain free forever.

When students create programs, they learn important mathematical and computing concepts that improve their creative thinking, logical reasoning, problem solving, and collaboration skills. Scratch can be used for multiple purposes. Kids can make animations, teens can develop game and even teachers and students can use it to create effective education tools such as math quiz, science simulation, and educational videos. Scratch is so easy that anyone can master using it within very short period.

Scratch can either be downloaded from MIT website for offline use or used online directly in the web browser.

7.1.1 Downloading and installing scratch offline

You can download and install Scratch on a computer or an android device to work offline. The latest version of scratch can be downloaded for Windows 10 or Android 6 or later versions. However, Scratch 2.0 is a good version that works on most of the computers. Scratch 2.0 can be downloaded from this website: <https://scratch.mit.edu/download/scratch2>

The instructions in this unit are based on Scratch 2.0. However, teachers and students can use the latest version as well.



Fig.7.1 Scratch Downloading

To begin, **Scratch Offline Editor** for Windows needs to be installed on to your computer.

Installation of Scratch is very easy.

1. After downloading we need to just run the executable (exe) file.
2. The first screen will appear which will ask the location where we want to install the Scratch.
3. It will also ask about the shortcuts to create. You need to just continue with default options.
4. This will initiate the installation process and after installation, Scratch will be ready to use.



Fig.7.2 Scratch Editor

7.1.2 Scratch online

Scratch can also be used online by simply loading its editor in our web-browser which is available at:

<https://scratch.mit.edu/projects/editor>

After loading the editor, it will function just like the offline editor. We can also create our account on Scratch. This will enable us to save our projects online.

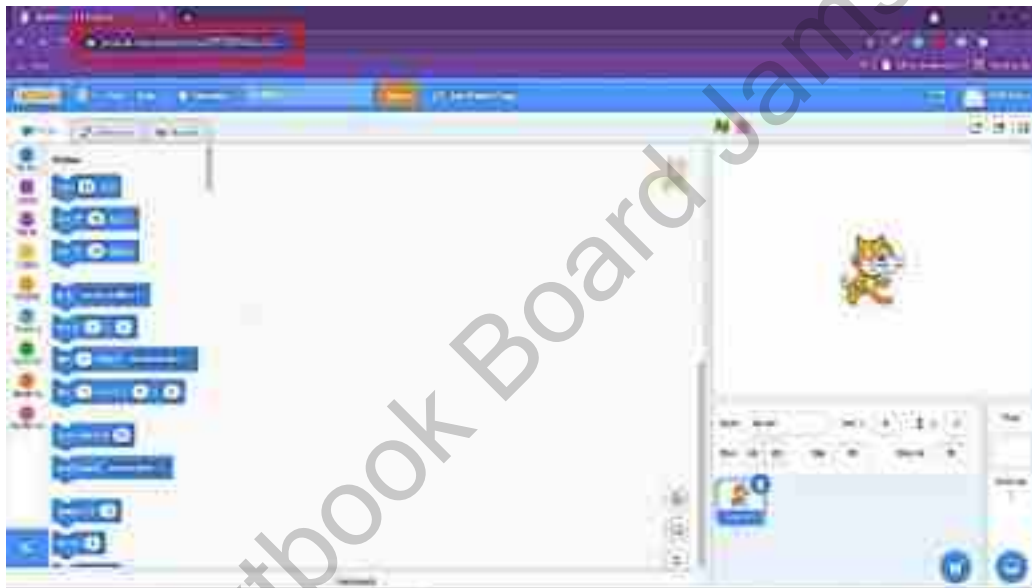


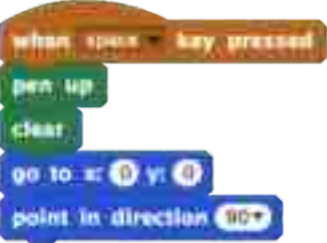
Fig.7.3 Scratch Online



- ◆ Explain the environment and tools in Scratch including sprite and scripts
- ◆ Demonstrate the use of Code, Costumes and Sound Tabs

7.2 UNDERSTANDING SCRATCH ENVIRONMENT

Before we start understanding the environment of Scratch, we must understand the two basic concepts, i.e., **Sprites** and **Scripts**.

Sprites	The sprites are the images of cartoons, characters or objects that we add in our project. We can have multiple sprites in our project but at least one sprite is always needed for the project. Cat is the default sprite in the Scratch.	
Scripts	To create a game, interactive story, animation or artwork in Scratch, you must add visual instructions to tell a sprite exactly what to do. The scripts are instructions that make sprites perform a task. Each sprite in a Scratch project has an area for scripts through which it is programmed. Clicking on a sprite's thumbnail in the sprite pane will bring up the script area of that sprite.	

7.2.1 Scratch editor:

Following are the different components of Scratch Editor.

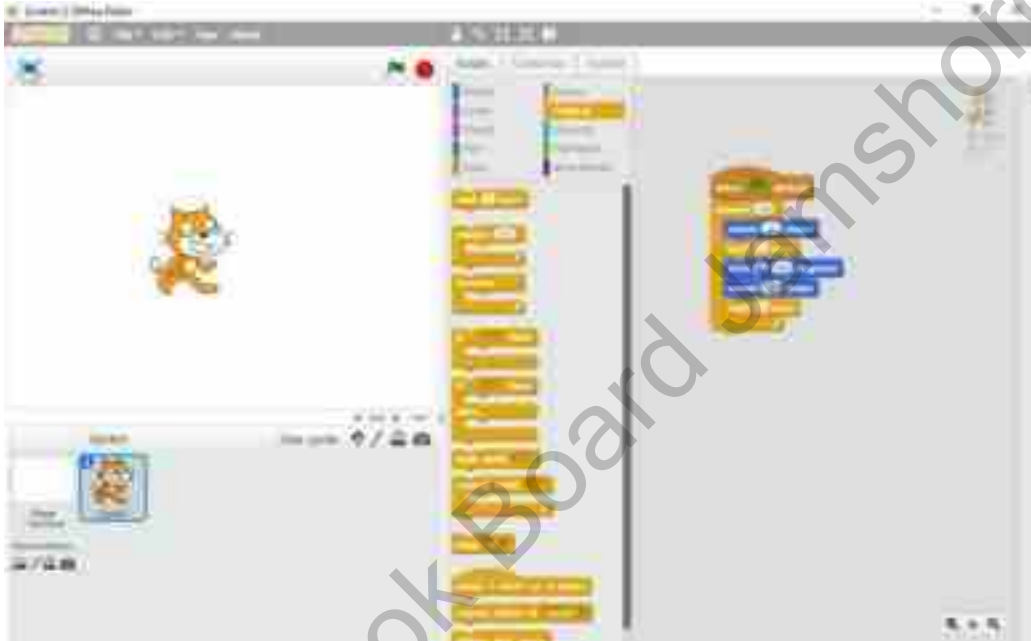


Fig. 7.4 Stage Preview

- **Stage or Stage Preview Window:**

This is where you can immediately see the output of your codes. The project runs physically in this window. It is the main working area where the sprite moves and performs actions according to the given instructions. It is divided into x (horizontal) and y (vertical) coordinates. The coordinates are displayed at the bottom right corner of the stage. These coordinates indicate the position of the sprite on the stage.

- **Script Area:**

This shows your code or program. You can drag blocks from the palette to this area and create scripts by placing them together. Script is the set of step wise instructions that you give to the Sprite to do a particular task. Each Sprite has its own Script Area.

- **Sprite List:**

It displays the thumbnails of all the sprites available in a project. You can click the blue information icon on any sprite to change its name and behavior.

- **Backdrop:**

A backdrop is the background that we can add on our stage. By default, there is no backdrop is added in a project. You may change how your stage looks by adding new backdrops.

- **Script Block:**

Script Area has three different Tabs. A Tab is a small form or area that contains similar command or options.

- **Script Tab (Code Tab in Scratch 3):**

You can think of this area as your toolbox. When you click on this Tab, the block palette will open. You tell the Sprites exactly what to do by giving them commands. A command is an instruction to do a particular task. In Scratch these commands are shown in the form of Code Blocks in the Blocks Palette. The block palette consists of every block of instruction that is built into Scratch. The commands regarding specific tasks are joined together in different blocks like Motion, Looks and Sensing. Each block has an associated color that differentiates different commands.

The following table describes the purpose of each block.

Blocks	Purpose	Examples
Motion	These codes are used to move the Sprite on the stage.	Move; Turn; go to x,y; if on edge, bounce;
Events	Events trigger specific code at a particular time or action.	when flag is clicked; when space key is pressed, when backdrop switches to.
Sound	This is used to play sound.	Play sound; play drum 1 for 0.25 beats, play note 60 for 0.5 beats.
Looks	These codes are used to change the appearance of the Sprite and Backdrop.	Say, Think, Switch Costume to and Switch Backdrop to are some commonly used codes.
Control	These codes control the actions on the stage.	wait 1 sec, repeat 10, forever, if then.
Sensing	These codes sense any specific happening	touching mouse pointer, touching color, ask and wait
Data	These are used to initialize variables and list	variable and lists
Pen	This used to draw lines, rectangles and other shapes	pen up, pen down, pen color
Operators	This shows the available arithmetic, logical and relational operators	+; -; *; /; <; >; =

- **Costume Tab:**

The appearance of a sprite can also be changed. You can change the costume of a sprite clicking on “**Costumes**” tab and clicking on the desired costume of choice, or by using blocks to select the sprite’s costume. New costumes for the sprite can be Imported, Created, and Edited in the Scratch Paint Editor.

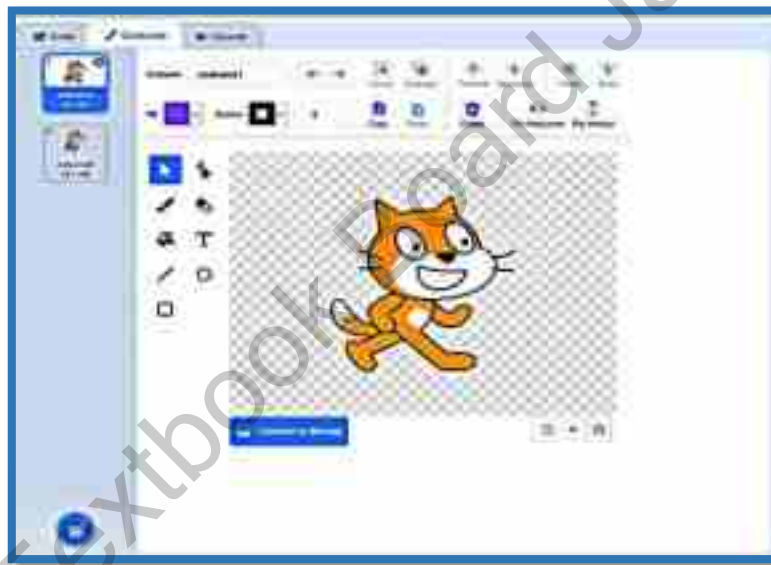


Fig. 7.5 Costumes Tab

- **Sound Tab:**

Some sprites additionally have at **least one sound**. Unlike costumes, sounds are an optional field, so you can have a sprite with no sounds. The sounds tab allows you to add, delete, and edit sounds. Sounds can be played in the sound editor or with blocks that play a specific sound.



Fig. 7.6 Sound Tab

- **Cursor Tool:**

You can find Cursor Tool on the right top of the editor. It includes five options; Duplicate, Delete, Grow, Shrink and Help. To Duplicate a sprite, just click on the stamp and then on the Sprite. Same is applicable on Delete, Grow and Shrink.



Fig. 7.7 Cursor Tab

Teachers Note	
	Students may have many questions at this point. Teachers are expected to spend some time to demonstrate important code with example.



- **Basics about Creating Program:**

Few points should be kept in mind before developing a project.

- Most of the Scratch Programs contain Sprites, Backdrops and Code Blocks.
- Every Sprite in a program has a separate Code Block which controls its actions.
- You can develop programs for different logics like storytelling, sprite animation, simple game and others.

Following steps are generally taken to develop a simple program in Scratch.

Open Scratch Editor

- From Events Option in Script, drag and drop on script area.
- From Control Option, drag **forever** and drop on script area. Inside the **forever** block, drag and drop the illustrated commands and change values accordingly. Colors will help you to find the option. After completing the codes blocks, Play (Run) and Stop the program.



Fig. 7.8 Sample Program

- **Playing and Stopping the Animation/Program:**

To start your program or to test your code click the *Green Flag* icon located above the Stage panel. To stop your program, click the *Red Stop* icon.



Fig. 7.9 Play and Stop

What is the output of this program? Let's try to break the logic of this program.

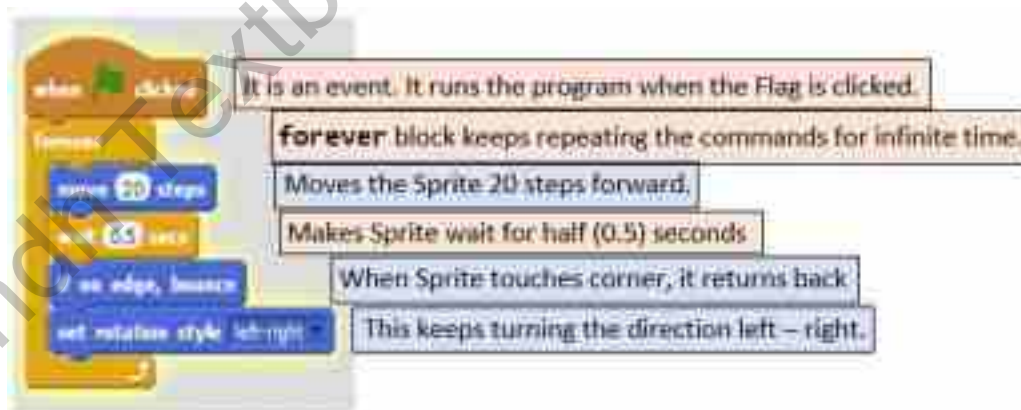


Fig. 7.10: Program Explanation

- **Coordinates on Scratch Stage:**

Scratch has a two-dimensional (2D) coordinate system; “X position” and “Y position” to determine the location of a sprite on the stage. The “X position” value determines the horizontal location of the sprite and the “Y position” value determines the vertical location.

As shown in figure 7.15, the screen in Scratch is a 480×360 rectangle. The X position can range from -240 to 240, where -240 is the leftmost a sprite can be and 240 is the rightmost, and the Y position can range from 180 to -180, where 180 is the topmost it can be and -180 is the bottommost it can be.

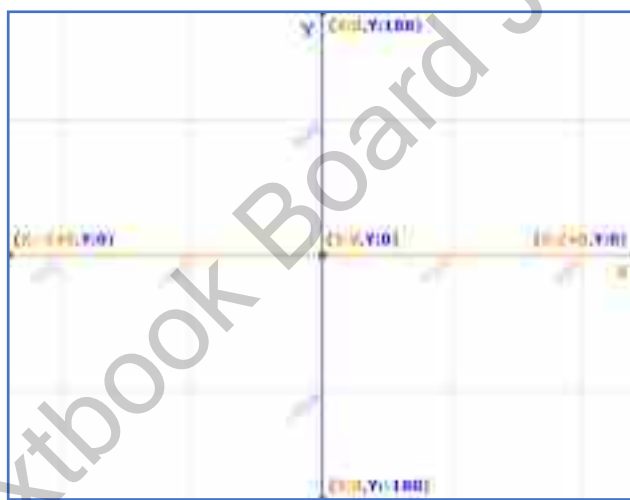


Fig 7.11 Coordinate Stage

Teachers Note	Teachers can connect the concept of the coordinates in mathematics. For better understanding some sample programs may be demonstrated and given as lab assignment.
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7.2.2 Some Important Commands in Scratch:

Here are some important commands that are usually used to develop simple programs.

Command	Group	Purpose
	Event	It triggers the following code blocks when  is clicked
		It triggers the following code blocks when a specific key is pressed
	Motion	Moves the sprite in current direction for specified steps
		Turns Sprite to specified degree
		Sends Sprite to specified x, y coordinates (position on stage)
		Sprite glides to specified x, y coordinates (position on stage)
	Control	Waits for specified seconds
		Repeats the following code blocks for specified number of times.
		Keeps repeating the following code blocks for infinite times.
		Executes the block when given condition is true.
	Sound	Plays the specified sound.
		Plays the specified drums sound for specified beats.
		Plays the specified note for specified beats.
		Changes the musical instrument.

	Looks	Says the given words for specified seconds.
		Says the given phrase.
		Pretends to think by showing given phrase for specified seconds.
		Pretends to think by showing given phrase.
		Changes the costume to the selected value.
		Changes the background to the selected value.
		Changes the size of Sprite.
	Pen	Pen is down. Now a line is drawn as Sprite moves.
		Pen is up.
		Sets the color of the pen to draw line.

7.3 Developing Programs in Scratch

After learning some frequently used commands, let's develop few programs. Try developing the illustrated program.

1. Changing the Costume:

With this small set of code blocks (Fig. 7.12), the costume of the Sprite changes and it looks as if the Sprite is moving. Can you explain this program?



Fig. 7.12 Change Costume

2. Adding and Moving Sprite

For next program you should right click on the Sprite (Cat) and delete it. Now you don't have any Sprite in your project.

- To add a Sprite, click on "Choose sprite from library". This will open a dialogue box showing all available Sprites. Select Beetle from the list.
- On the Stage, Move the Beetle to the Upper- left corner.
- Now add the following codes.

What is the output? The beetle is moving clock-wise in rectangular shape. Can you change its movement to antilock-wise? Can you write the logic of this program in simple words?



Fig. 7.13 Scratch Program

3. Playing Sound in Scratch:

We can add sounds in our projects. It is very simple and easy. We can play different sounds like beat the drum or play different notes. You can use these sounds to make any animation, game or even just creating music. You can find complete list of notes and beats on following link. <https://en.scratch-wiki.info/>

- In this sample program, notes are used to create the music of a song.
- Try to develop this program and write the output of this program.

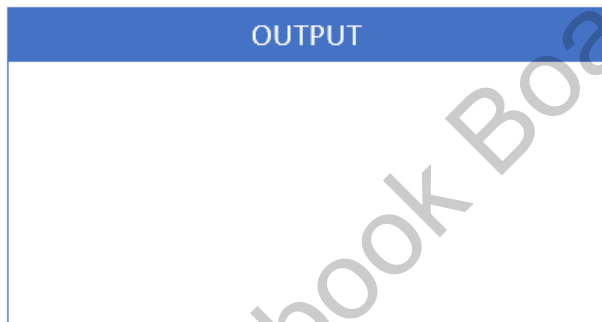
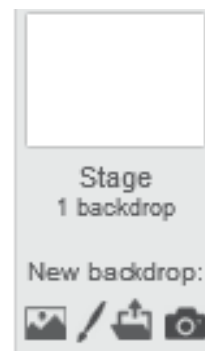


Fig. 7.14 Playing Sound

4. Changing the Backdrops:

By default, the Backdrop of stage is white/ blank. It can be changed. Place the cursor on "Choose a Backdrop" button and click. It consists of four different options:

- **Choose a backdrop from library:**
You can choose a backdrop from available library of backdrops.
- **Paint New backdrop:**
You can also paint a new backdrop
- **Upload backdrop from file:**
An image on your computer can also be used as backdrop



- **New backdrop from Camera:**

You can also capture a picture through webcam and use it as backdrop.

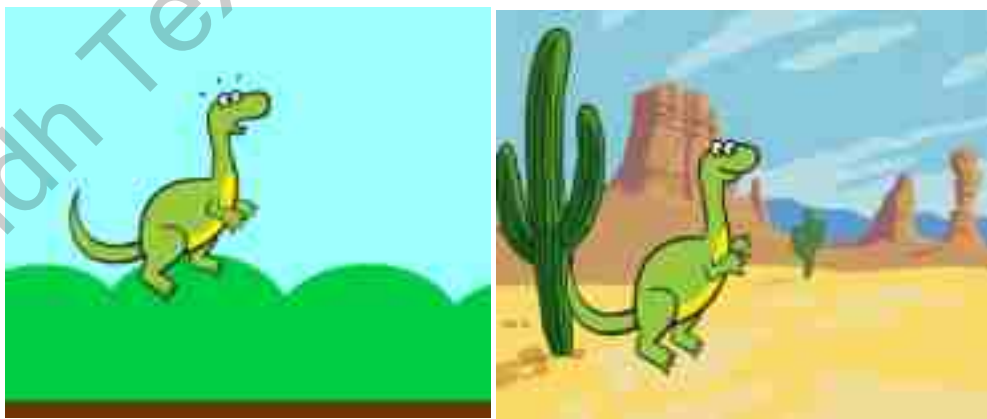
After adding a backdrop, you can use it in your program. Let's practice this skill. For developing this program, you need to add two backdrops in your program; add Blue Sky and Desert backdrops. Also delete cat from Sprite List and add Dinosaur1 as Sprite.

By using relevant blocks, try to develop this illustrated program.

After finishing coding, run this program. If you have done all things right, you will find a dinosaur, moving lazily on your stage and as it crosses the stage, the other Backdrop (Desert) appears on the stage and the dinosaur feels happy. Now, try to understand each line of your program and in your notebook write the purpose of each command.



Fig. 7.15 Changing Backdrop



5. Using Multiple Sprites:

We can have multiple sprites in our project. At least one sprite is always needed for the project. Just like New Backdrop, there are four ways to add different Sprite in our project. These are; **Choose sprite from library**, **Paint New Sprite**, **Upload Sprite from file** and **New Sprite from Camera**.

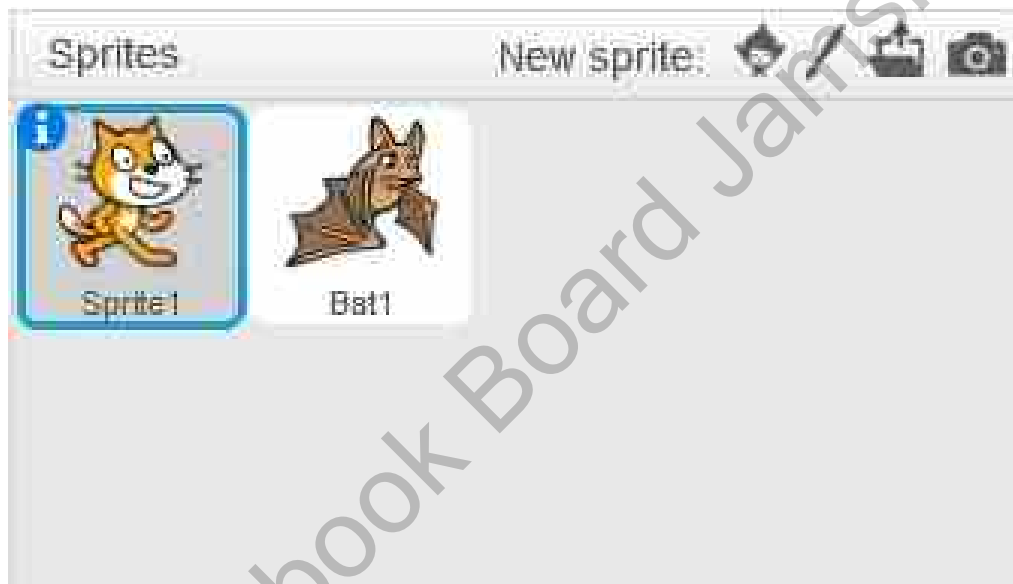


Fig. 7.16 Using Multiple Sprites

Here is a program in which two Sprites are used. Follow these steps to develop this program.

Add Bat as the second Sprite in you Sprite List.

This time you need to write codes for both Sprites.

Write the following code for each Sprite.



For Bat 1



For Sprite 1



Fig. 7.17 Multiple Sprites Program

To run this program, click on flag icon. Then press the Space Key from keyboard. Observe the output of this program and write it in your notebook. In a group, discuss the logic of this program with your class-fellows. Remember, using multiple Backdrops and/or Sprites make your program more interactive and interesting.

6. Taking Input:

Scratch also allows developer to take input from the user. This illustration shows a simple program to take the input. In this program you can use *ask* command in which you may write your message, like in this example, name of user is asked. The third line is important and you need to add *say* command and join the *answer* command with this. The input that you take in *ask* is stored in *answer* and it is displayed using *say*.

Let's develop a program.

1. First line will start the program.

2. you can find *ask* and *wait* commands in **Sensing Block**. You may add your message in these code blocks.

3. You can find *set-to* command in **Data block**. For this program you will also need to create two variables from **Data Block**. For creating a variable click on

Make a Variable button. A message box will appear which will ask you for a name of the variable. Enter a name to create the variable. Drag *set* command and set variable names. Also add *answer* from **Sensing Block**. This line will store the value given by the user into variable called "Obtained Marks".



Fig. 7.18 Taking Input



Fig. 7.19 Program for Input



Fig. 7.20 Creating Variable

4. Same as Line 2.
5. Same as Line 3.
6. You can add say command from **Looks Block** and enter your message.
7. For creating this code, first add multiplication operator  from **Operator Block** and give the value 100. Now add Division Operators from same block . Now inside the both operands set the variable . Place this code inside say command.
8. Same as Line 6.

By understanding the logic of this program, now you can calculate many other things. Remember, developing program is great activity and coding is going to be an important skill in future. Through some basic skills that you learned in this unit, you can develop many complex projects by using your creativity and imagination.



- Scratch is a programming language. It includes animations and games.
- We can create interactive stories, games, animation, music, art, and presentations.
- There are two basic components of a Scratch program; Sprite and Script.
- Scratch Environment includes: Stage or Stage Preview Window, Script Area, Sprite List, Backdrop, and Script Block.
- We can use Scratch online and offline.
- The Stage is where you see your stories, games, and animations come to life.
- The Script is the set of stepwise instructions that users give to the sprite to do a particular task.
- Backdrop is the background that the user can add on stage.
- Scratch blocks are organized into different categories in the left columns.
 - Motion block has instructions to make the Sprite move, such as number of steps to take, direction of motion, etc.,
 - Event is used to trigger code at a specific time or action.
 - Sound is used to play different sounds.
 - Looks is used to change the appearance of the Sprite and Backdrop.
 - Control is used to control the action on the stage.
 - Sensing is used to sense any specific happening.
- Backdrop is the background of stage.
- Costume is the appearance of Sprite.
- Scratch has a 2D coordinate system: “x position” and “y position”.
- User can choose Backdrop or Sprite from library, Paint New, Upload from File and Capture from Camera.
- Variables can be created through Data Pallet.

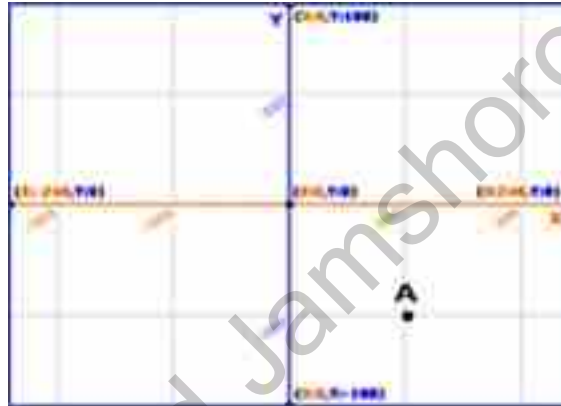


A. ENCIRCLE THE CORRECT ANSWER:

- i) The feature of Scratch is _____.
 a. It is a visual b. Its free forever
 c. No need to remember codes d. All of above
- ii) In Scratch, the character which moves on the Stage is called a _____.
 a. Sprite b. Command
 c. Script d. Event
- iii) Repeat 10, forever and if ... then codes are available in _____.
 a. Motion b. Control
 c. Look d. Sensing
- iv) The Looks of Sprite can be changed by using _____.
 a. Backdrop Tab b. Costume Tab
 c. Script Tab d. Control Tab
- v) A Scratch Program is at least made up with _____.
 a. Many Sprites b. One Sprite and Code
 c. One Sprite d. One Sprite and Backdrop
- vi) To change the position of Sprite on screen, we use _____.
 a. Coordinates b. Stage Information
 c. Command Pallets d. Costume Tab
- vii)  can be found under _____.
 a. Look b. Motion
 c. Sound d. Control
- viii) Turn command, turns Sprite to specified:
 Coordinate c) Steps
 Degree d) Seconds
- ix) This  command is available in _____.
 a. Event c. Control
 b. Motion d. Looks

- x) In the given picture identify the x and y coordinates (positions) of Point - A.

- $x=100, y=-100$
- $x=-100, y=100$
- $x=100, y=100$
- $x=-100, y=-100$



B. RESPOND THE FOLLOWING:

- Explain the following:
 - Script
 - Sprite
 - Backdrop
- State the difference between repeat 10 and forever commands.
- Write the use of the following codes: forever, wait, say, play sound, go to x, y
- What is the difference between using Scratch online and offline?
- In your notebook mark the color of each pallet in Script Tab. One is done for you. How are these colors helpful for the user?



LAB ACTIVITIES

1. Divide the class into groups. Make two sprite using photos of two students and write scripts for them to do an activity of your choice. Use your imagination to make them do actions by using motion and control blocks.
2. Draw a matrix of 480×360 and then mark these points on the that matrix:
 - a. $x = -170, y = 100$
 - b. $x = 110, y = 190$
 - c. $x = -120, y = -120$
 - d. $x = 150, y = 0$

Now with the help of *go to-x-y* command, check your marks on the matrix.

3. Make a list of your 5 favorite Backdrops and 5 favorite Sprites.
4. Make a sample program in which two Sprites talk with each other. Try making few jokes.
5. Develop a program to enter Radius of Circle; calculate area and circumference of the circle and display the result.
6. In a group, try to develop a story by using multiple Sprites and Backdrops.
7. If available, explore few ideas from <https://scratch.mit.edu/ideas> and make programs accordingly. You can also download Coding Cards and Starter Projects from this website.

Teachers Note

Teachers should encourage students to explore different resources and learn further themselves.