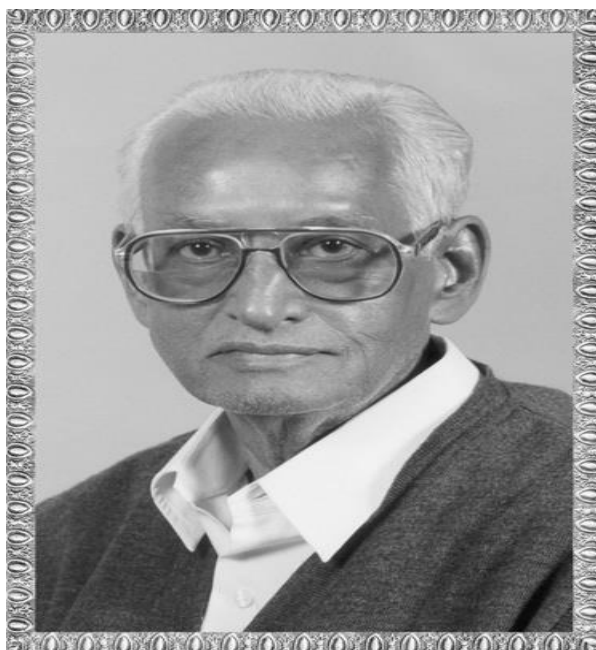


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Lt. Shree Chimanbhai Shukla

**MSCIT SEM-3 – FLUTTER APP
DEVELOPMENT**

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CS – 13 : Flutter App Development

SR.NO.	TOPIC	DETAIL
1	Introduction to Flutter and Dart	• Overview of Flutter and Dart • Overview of the Flutter architecture and how it works • Setting up the development environment • Dart syntax and data types • Basic Flutter widgets and layout • Basic Flutter widget properties and methods • Dart libraries and packages • Control flow and loops in Dart
2	Building User Interfaces	• Stateful vs. Stateless widgets • Layout and widgets hierarchy • Navigation and routing • Responsive design and media queries • Advanced Flutter widgets (e.g., SliverAppBar, AnimatedContainer) • Custom widget creation in Flutter • Debugging UI issues in Flutter • Advanced layout techniques (e.g., Flexbox, GridView)
3	Managing App State	• State management in Flutter • InheritedWidget and InheritedModel • ScopedModel and Provider • BLoC pattern for state management • Stream-based state management with RxDart

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		• Redux architecture for Flutter • Firebase integration for state management • Using the Flutter DevTools for debugging
4	Networking and Persistence	• RESTful APIs and HTTP requests • JSON serialization and deserialization • SQLite and local storage • Shared preferences and secure storage • WebSockets for real-time communication in Flutter • Firebase integration for data storage • Caching data in Flutter • Using third-party libraries for networking and data storage (e.g., Dio, Hive)
5	Animation, Integration, Testing, Debugging & Accessibility	• Animations and motion • Advanced animation techniques (e.g., Flare, Lottie) • Internationalisation and localization • Native platform integration • Push notifications in Flutter (Firebase) • Integration with other native features (e.g., camera, location) • Testing and debugging • Accessibility in Flutter apps

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CHAPTER-1

Introduction to Flutter and Dart

- ❖ Overview of Flutter and Dart
- ❖ Overview of the Flutter architecture and how it works
- ❖ Setting up the development environment
- ❖ Dart syntax and data types
- ❖ Basic Flutter widgets and layout
- ❖ Basic Flutter widget properties and methods
- ❖ Dart libraries and packages
- ❖ Control flow and loops in Dart

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Q-1 Explain Overview of Flutter With Features.

Answer:

- ❖ Flutter is an open source framework to create high quality, high performance mobile applications across mobile operating systems - Android and iOS.
- ❖ It provides a simple, powerful, efficient and easy to understand SDK to write mobile application in Google's own language, *Dart*.
- ❖ Flutter provides high performance by rendering the UI directly in the operating system's canvas rather than through native framework.
- ❖ Flutter also offers many ready to use widgets (UI) to create a modern application.
- ❖ These widgets are optimized for mobile environment and designing the application using widgets is as simple as designing HTML.
- ❖ Flutter application is itself a widget. Flutter widgets also supports animations and gestures.
- ❖ The application logic is based on reactive programming.
- ❖ Flutter apps use Dart programming language for creating an app.
- ❖ The first version of Flutter was announced in the year **2015** at the Dart Developer Summit.

Features of Flutter

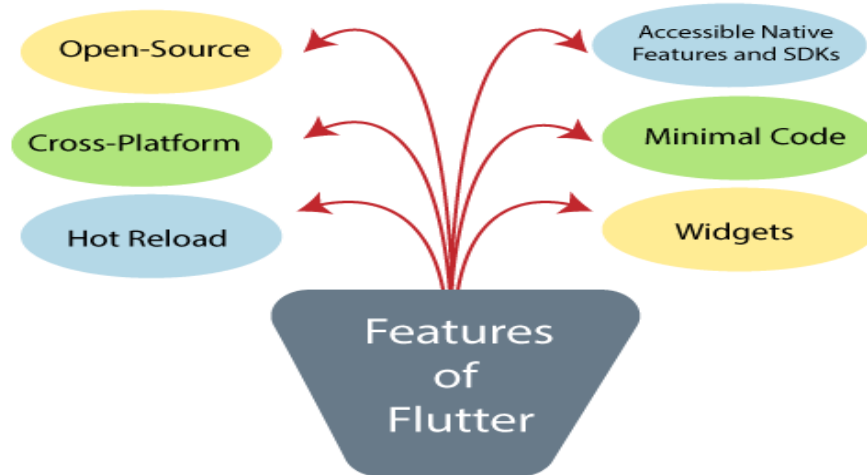
- ❖ Flutter gives easy and simple methods to start building beautiful mobile and desktop apps with a rich set of material design and widgets.
- ❖ Here are some main features of Flutter for developing the mobile framework.

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Open-

Source:

- ✓ Flutter is a free and open-source framework for developing mobile applications.

Cross-platform:

- ✓ This feature allows Flutter to write the code once, maintain, and can run on different platforms.
- ✓ It saves the time, effort, and money of the developers.

Hot Reload:

- ✓ Whenever the developer makes changes in the code, then these changes can be seen instantaneously with Hot Reload.
- ✓ It means the changes immediately visible in the app itself.
- ✓ It is a very handy feature, which allows the developer to fix the bugs instantly.

Accessible Native Features and SDKs:

- ✓ This feature allows the app development process easy and delightful through Flutter's native code, third-party integration, and platform APIs.

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✓ Thus, we can easily access the SDKs on both platforms.

Q-2 Explain Overview of Dart or Dart Programming.

Answer:

- ❖ Dart is an open-source general-purpose programming language.
- ❖ It is originally developed by Google.
- ❖ Dart is an object-oriented language with C-style syntax.
- ❖ It supports programming concepts like interfaces, classes, unlike other programming languages Dart doesn't support arrays.
- ❖ Dart collections can be used to replicate data structures such as arrays, generics, and optional typing.
- ❖ It supports most of the common concepts of programming languages like classes, interfaces, functions, unlike other programming languages.
- ❖ Dart language does not support arrays directly.
- ❖ It supports collection, which is used to replicate the data structure such as arrays, generics, and optional typing.
- ❖ The following example shows simple Dart programming.

```
void main()  
{  
    print("Dart language is easy to learn");  
}
```

Variables and Functions

- ❖ Variables are the namespace in memory that stores values. The name of a variable is called as **identifiers**.
- ❖ They are the data containers, which can store the value of any type.
For example:

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```
var myAge = 50;
```

- ❖ Here, **myAge** is a variable that stores an integer value 50.
- ❖ We can also give it int and double.
- ❖ However, Dart has a feature Type Inference, which infers the types of values. So, if you create a variable with a **var** keyword, Dart can infer that variable as of type integer.
- ❖ Besides variable, Functions are another core feature of any programming language.
- ❖ Functions are a set of statements that performs a specific task.
- ❖ They are organized into the logical blocks of code that are readable, maintainable, and reusable.
- ❖ The function declaration contains the function name, return type, and parameters.
- ❖ The following example explains the function used in Dart programming.

//Function declaration

```
num addNumbers(num a, num b)
{
    // Here, we use num as a type because it should work with int and double both.
    return a + b;
}
var price1 = 29.99;
var price2 = 20.81;
var total = addNumbers(price1, price2);
var num1 = 10;
var num2 = 45;
var total2 = addNumbers(num1, num2);
```

Q-3 Explain Architecture of Flutter With How it works.

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Answer:

- ❖ In *Flutter*, the application is itself a widget.
- ❖ The application is the top- level widget and its UI is build using one or more children (widgets), which again build using its children widgets.
- ❖ This **composability** feature helps us to create a user interface of any complexity.
- ❖ The Flutter architecture mainly comprises of four components.

1. Flutter Engine
2. Foundation Library
3. Widgets
4. Design Specific Widgets

Flutter Engine

- ❖ It is a portable runtime for high-quality mobile apps and primarily based on the C++ language.
- ❖ It implements Flutter core libraries that include animation and graphics, file and network I/O, plugin architecture, accessibility support, and a dart runtime for developing, compiling, and running Flutter applications.
- ❖ It takes Google's open-source graphics library, **Skia**, to render low-level graphics.

Foundation Library

- ❖ It contains all the required packages for the basic building blocks of writing a Flutter application.
- ❖ These libraries are written in Dart language.

Widgets

- ❖ In Flutter, everything is a widget, which is the core concept of this framework.

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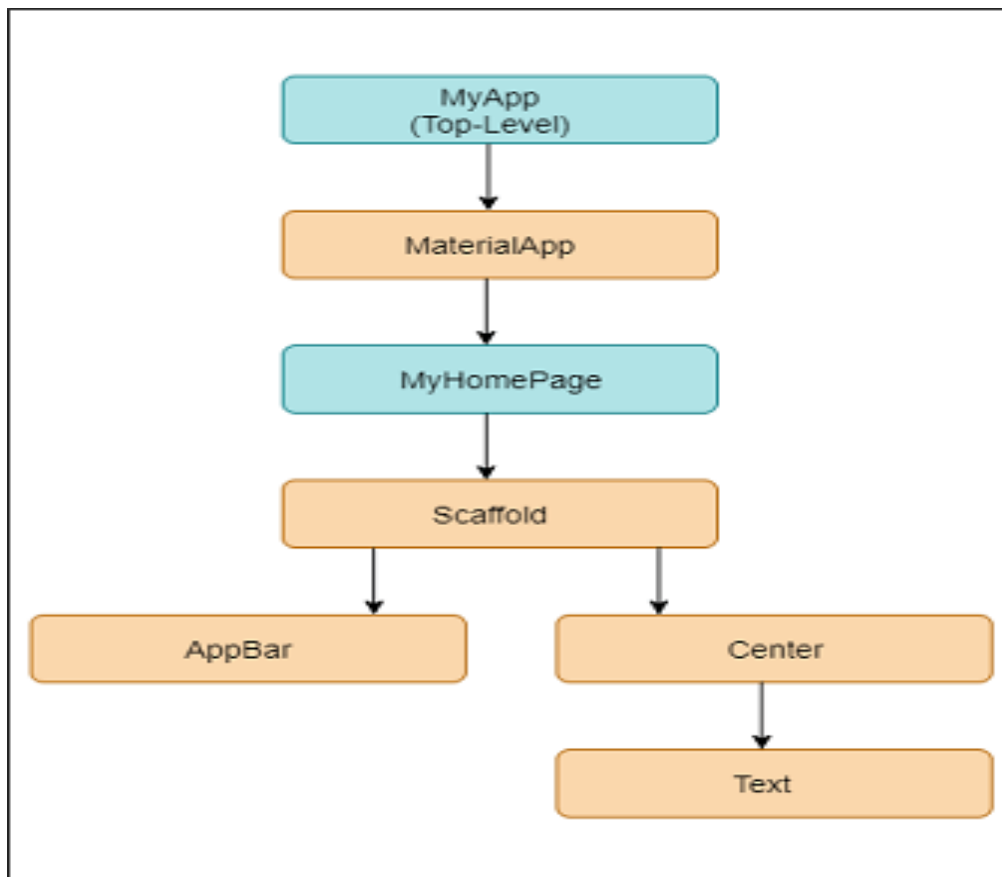
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- ❖ Widget in the Flutter is basically a user interface component that affects and controls the view and interface of the app.
- ❖ It represents description of part of the user interface and includes graphics, text, shapes, and animations that are created using widgets.
- ❖ The widgets are similar to the React components.
- ❖ Here, we are going to explain the example with the following diagram.



In the above example, we can see that all the components are widgets that contain child widgets. Thus, the Flutter application is itself a widget.

Design Specific Widgets

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- ❖ The Flutter framework has two sets of widgets that conform to specific design languages.
- ❖ These are Material Design for Android application and Cupertino Style for IOS application.

✓ Gestures

- ❖ It is a widget that provides interaction (how to listen for and respond to) in Flutter using GestureDetector.
- ❖ **GestureDector** is an invisible widget, which includes tapping, dragging, and scaling interaction of its child widget.
- ❖ We can also use other interactive features into the existing widgets by composing with the GestureDetector widget.

✓ State Management

- ❖ Flutter widget maintains its state by using a special widget, StatefulWidget.
- ❖ It is always auto re-rendered whenever its internal state is changed.
- ❖ The re-rendering is optimized by calculating the distance between old and new widget UI and render only necessary things that are changes.

✓ Layers

- ❖ Layers are an important concept of the Flutter framework, which are grouped into multiple categories in terms of complexity and arranged in the top-down approach.
- ❖ The topmost layer is the UI of the application, which is specific to the Android and iOS platforms.
- ❖ The second topmost layer contains all the Flutter native widgets.
- ❖ The next layer is the rendering layer, which renders everything in the Flutter app.

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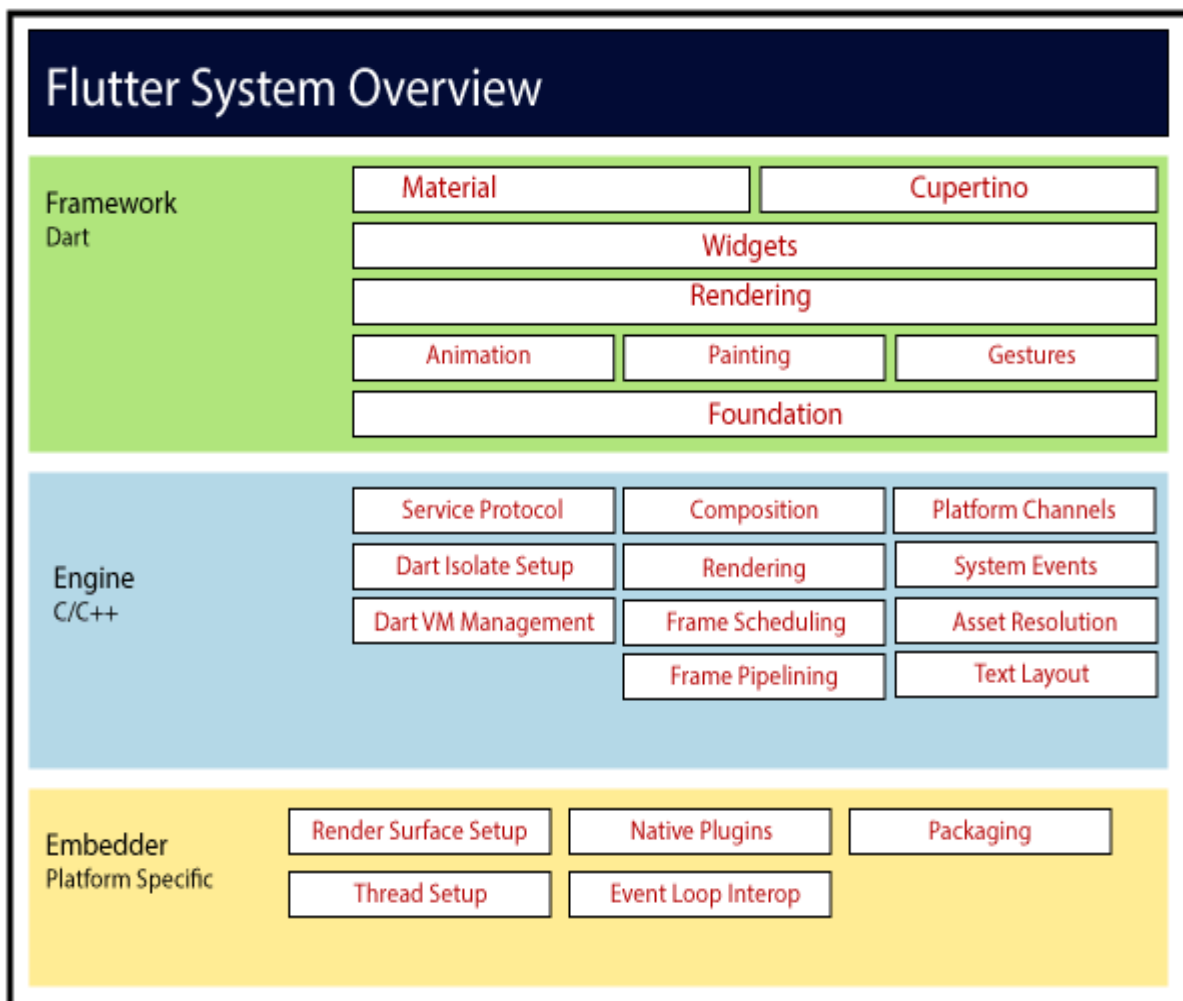
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- ❖ Then, the layers go down to Gestures, foundation library, engine, and finally, core platform-specific code. The following diagram specifies the layers in Flutter app development.



Q-4 Explain How to set up Development Environment ?

Answer:

- ❖ Here , We can see how to set up an environment for the successful development of the

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Flutter application.

System requirements for Windows

- ❖ To install and run Flutter on the Windows system, you need first to meet these requirements for your development environment.

Operating System	Windows 7 or Later (I am Windows 10. You can also use Mac or Linux OS.).
Disk Space	400 MB (It does not include disk space for IDE/tools).
Tools	1. Windows PowerShell 2. Git for Windows 2.x (Here, Use Git from Windows Command Prompt option).
SDK	Flutter SDK for Windows
IDE	Android Studio (Official)

Install Git

Step 1: To download Git, [click here](#).

Step 2: Run the .exe file to complete the installation. During installation, make sure that you have selected the recommended option.

Install the Flutter SDK

Step 1: Download the installation bundle of the Flutter Software Development Kit for windows. To download Flutter SDK, Go to its official [website](#), click on **Get started** button, you will get the following screen.

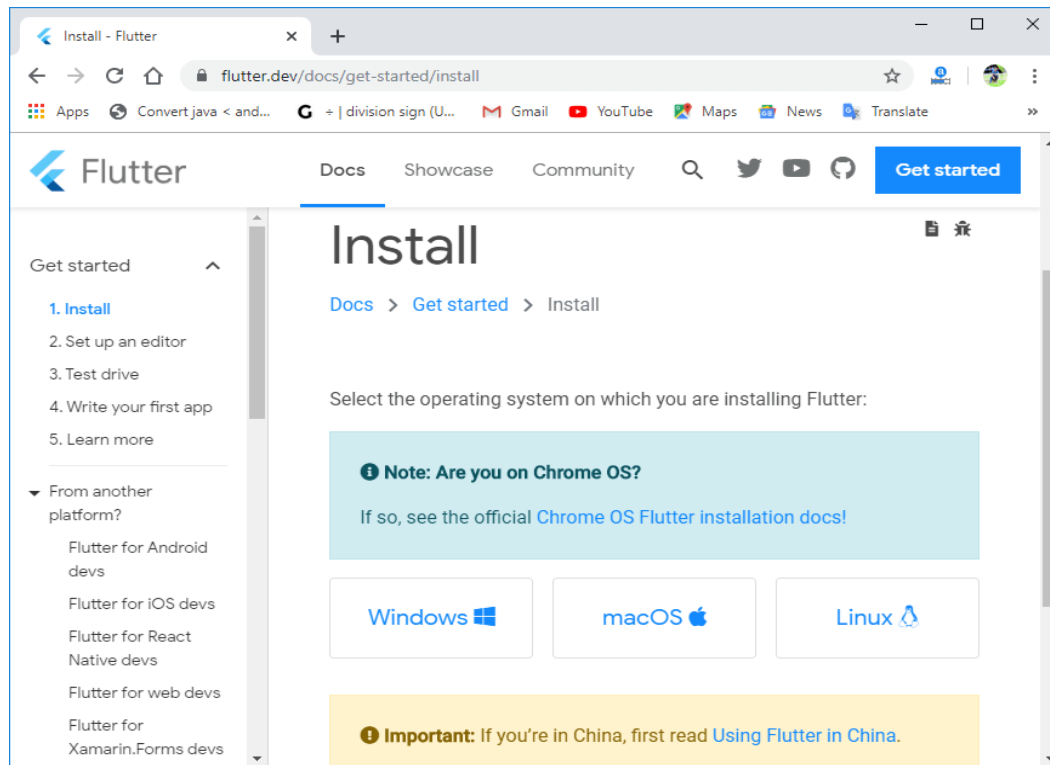
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Step 2: Next, to download the latest Flutter SDK, click on the Windows icon. Here, you will find the download link for [SDK](#).

Step 3: When your download is complete, extract the **zip** file and place it in the desired installation folder or location, for example, D: /Flutter.

Note: The Flutter SDK should not be placed where the administrator's permission is required.

Step 4: To run the Flutter command in regular windows console, you need to update the system path to include the flutter bin directory. The following steps are required to do this:

Step 4.1: Go to MyComputer properties -> advanced tab -> environment variables. You will get the following screen.

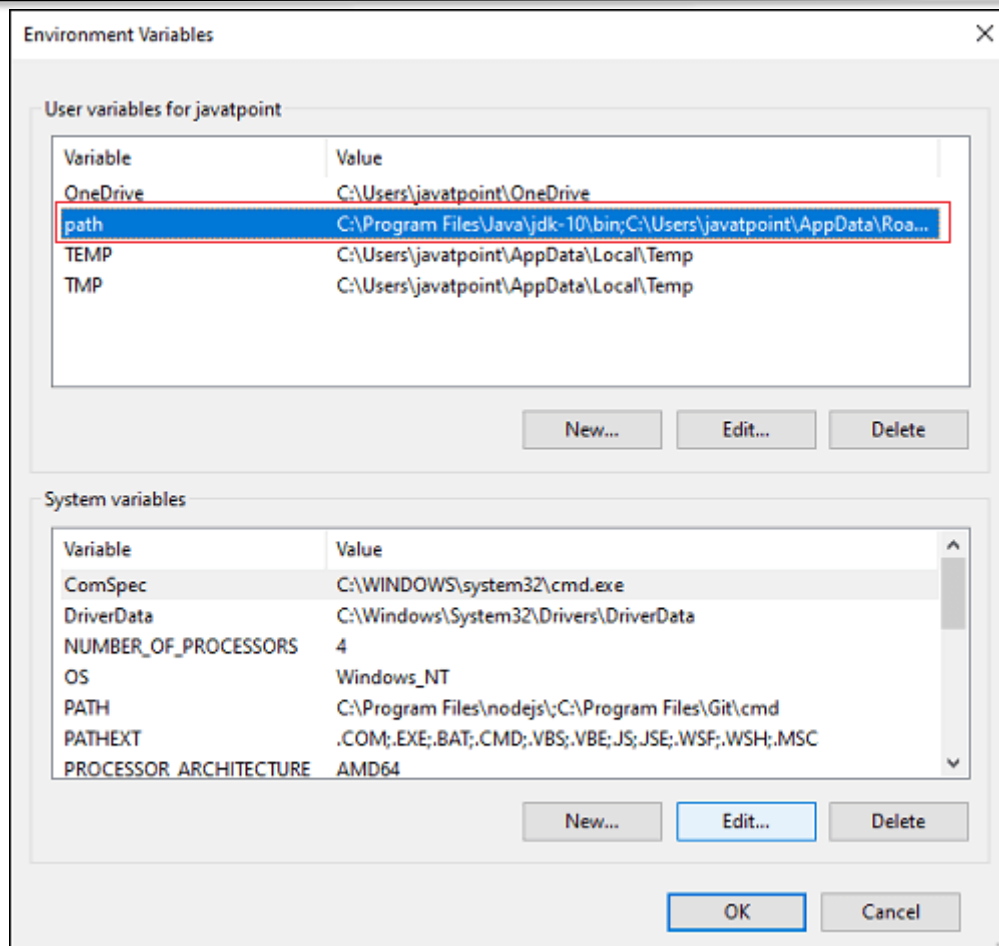
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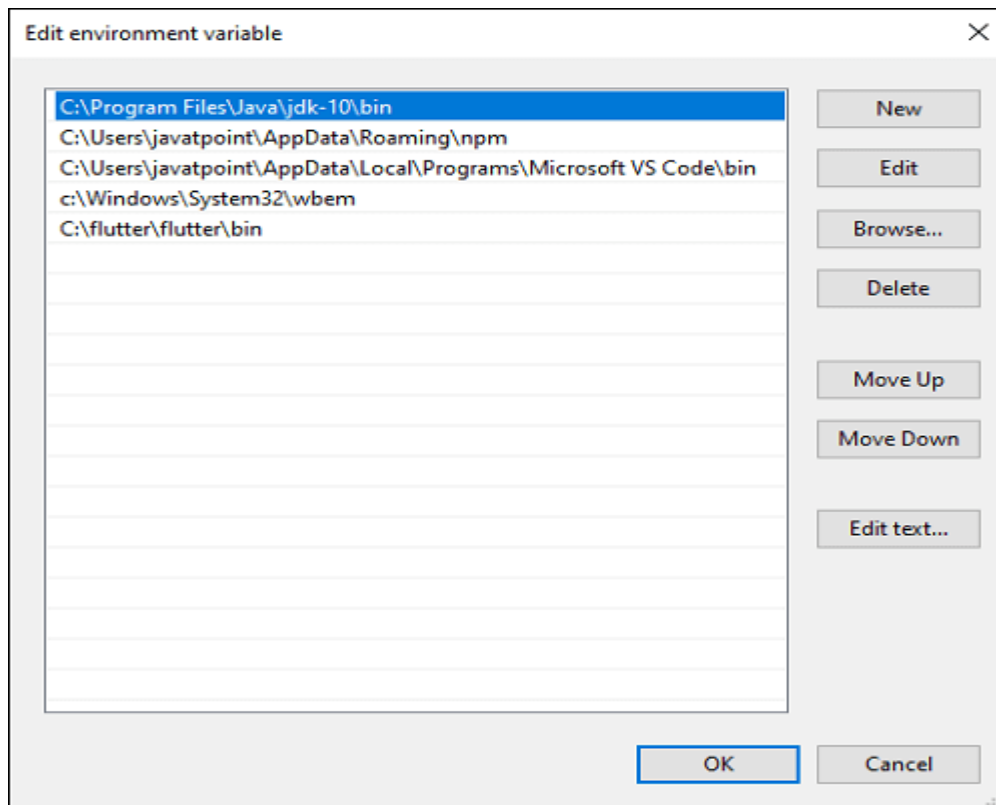
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Step 4.2: Now, select path -> click on edit. The following screen appears.



Step 4.3: In the above window, click on New->write path of Flutter bin folder in variable value -> ok -> ok -> ok.

Step 5: Now, run the **\$ flutter doctor** command. This command checks for all the requirements of Flutter app development and displays a report of the status of your Flutter installation.

1. \$ flutter doctor

Step 6: When you run the above command, it will analyze the system and show its report, as shown in the below image.

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Here, you will find the details of all missing tools, which required to run Flutter as well as the development tools that are available but not connected with the device.

```
Command Prompt
C:\Users\javatpoint>flutter doctor
Doctor summary (to see all details, run flutter doctor -v):
[✓] Flutter (Channel stable, v1.9.1+hotfix.6, on Microsoft Windows [Version 10.0.18362.476], locale en-IN)
[X] Android toolchain - develop for Android devices
    X Unable to locate Android SDK.
      Install Android Studio from: https://developer.android.com/studio/index.html
      On first launch it will assist you in installing the Android SDK components.
      (or visit https://flutter.dev/setup/#android-setup for detailed instructions).
      If the Android SDK has been installed to a custom location, set ANDROID_HOME to that location.
      You may also want to add it to your PATH environment variable.

[!] Android Studio (not installed)
[!] VS Code (version 1.40.1)
    X Flutter extension not installed; install from
      https://marketplace.visualstudio.com/items?itemName=Dart-Code.flutter
[!] Connected device
    ! No devices available

! Doctor found issues in 4 categories.
```

Step 7: Install the Android SDK. If the flutter doctor command does not find the Android SDK tool in your system, then you need first to install the Android Studio IDE. To install Android Studio IDE, do the following steps.

Step 7.1: Download the latest Android Studio executable or zip file from the [official site](https://developer.android.com/studio).

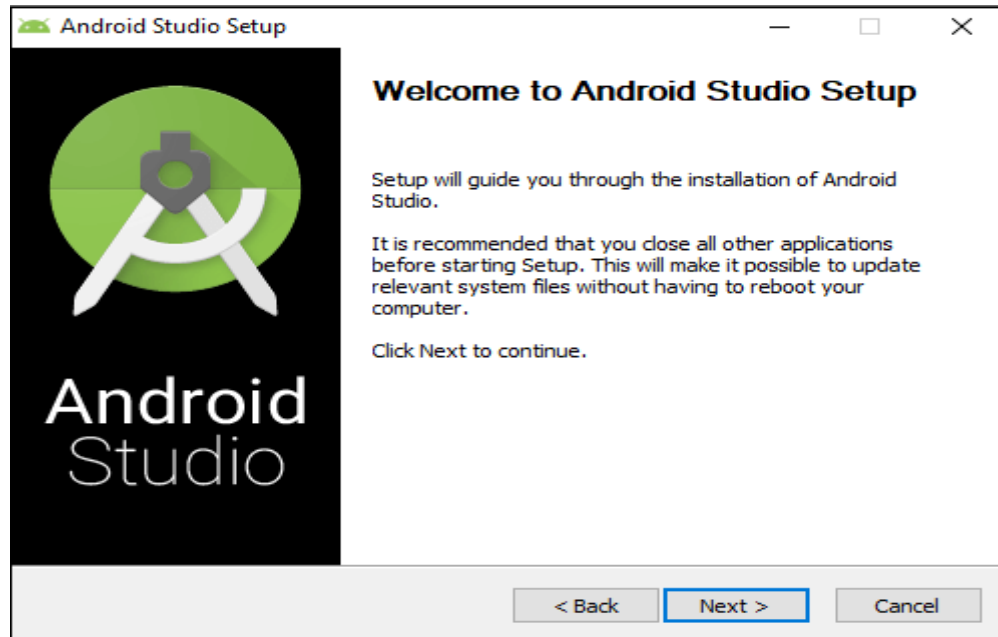
Step 7.2: When the download is complete, open the .exe file and run it. You will get the following dialog box.

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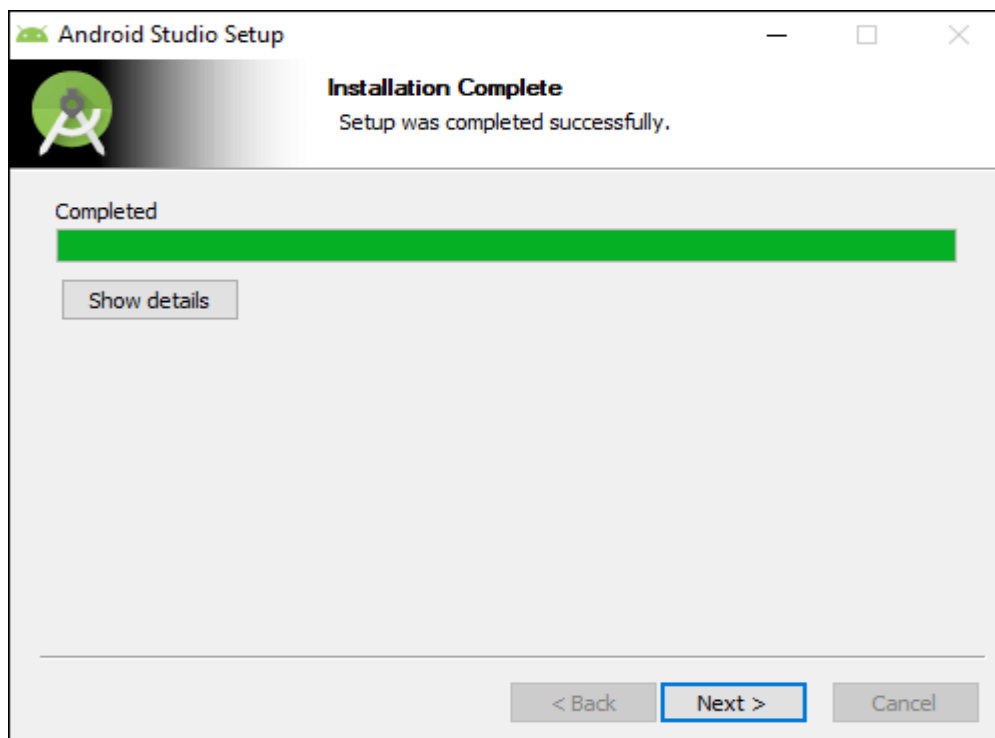


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Step 7.3: Follow the steps of the installation wizard. Once the installation wizard completes, you will get the following screen.



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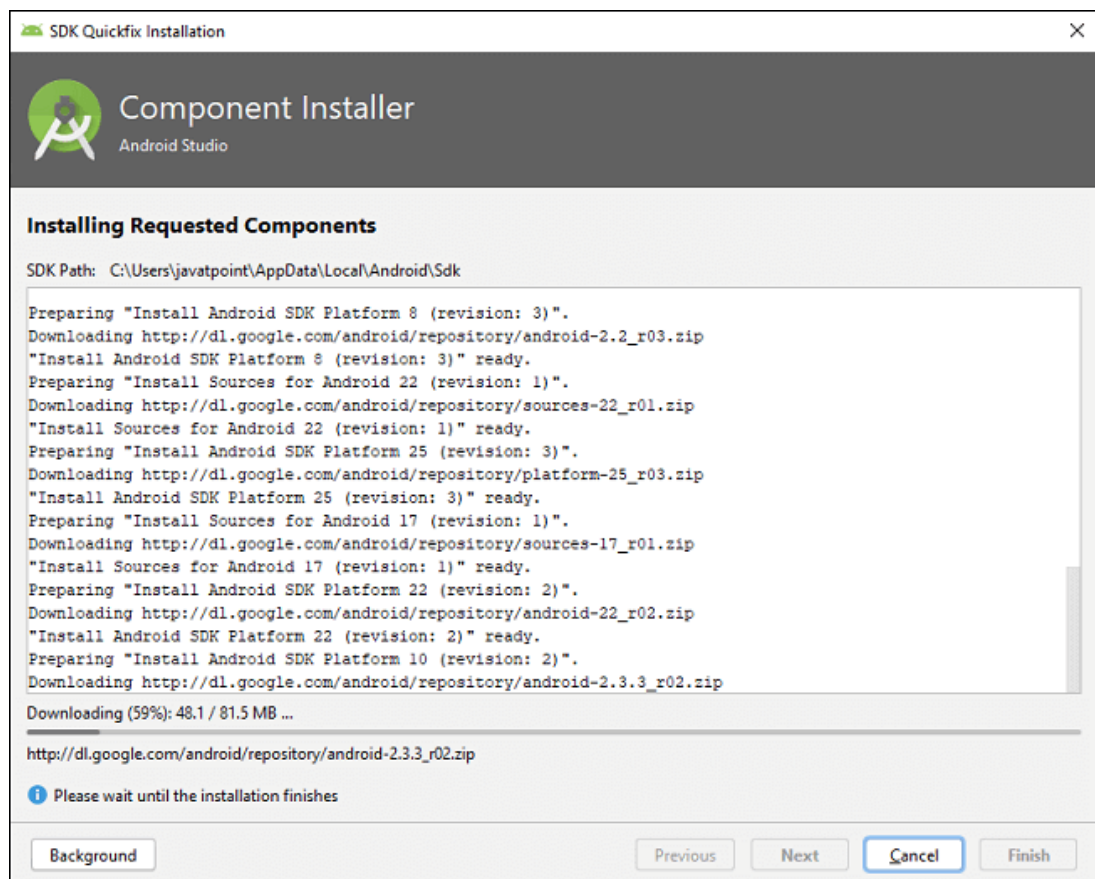


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Step 7.4: In the above screen, click Next-> Finish. Once the Finish button is clicked, you need to choose the 'Don't import Settings option' and click OK. It will start the Android Studio.

Note:> Meanwhile, the installation wizard also includes downloading Android SDK components that are required by Flutter for development.



Step 8: Next, you need to set up an Android emulator. It is responsible for running and testing the Flutter application.

Step 8.1: To set an Android emulator, go to Android Studio > Tools > Android > AVD Manager and select Create Virtual Device. Or, go to Help->Find Action->Type Emulator in the search box. You will get the following screen.

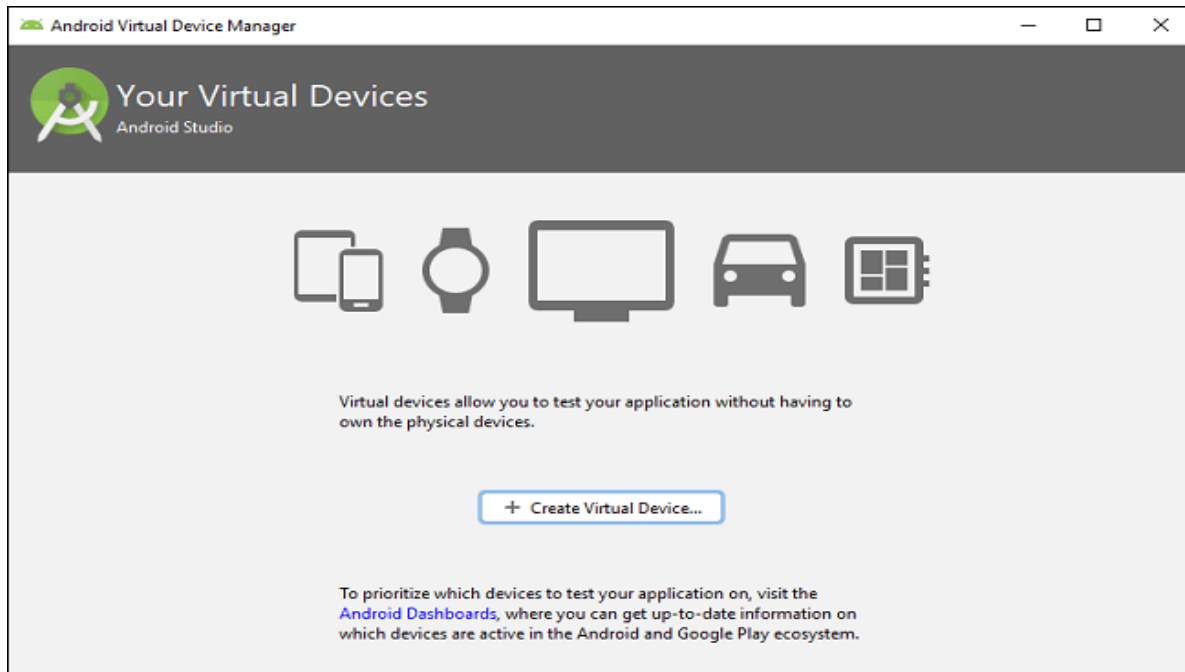
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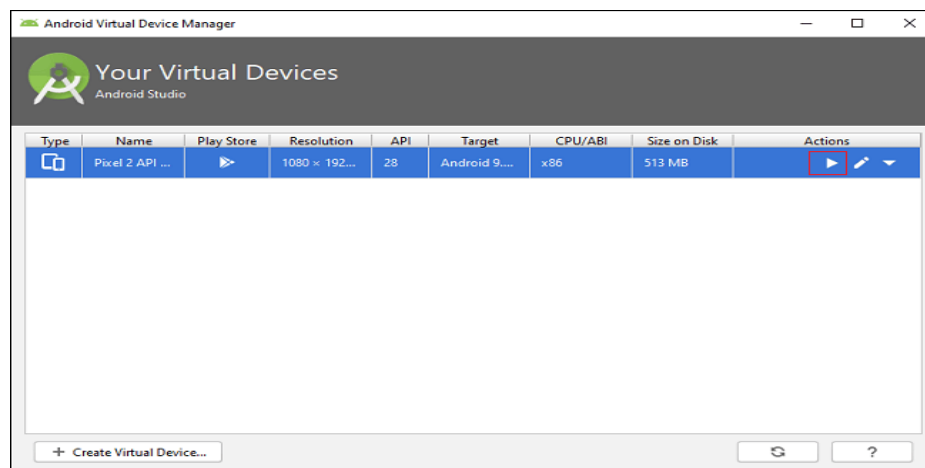
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Step 8.2: Choose your device definition and click on Next.

Step 8.3: Select the system image for the latest Android version and click on Next.

Step 8.4: Now, verify the all AVD configuration. If it is correct, click on Finish.
The following screen appears.



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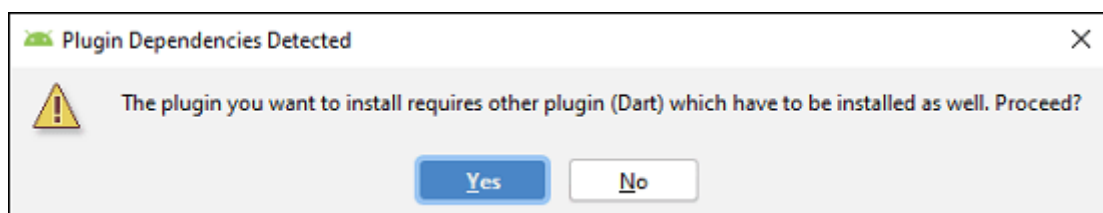
Step 8.5: Last, click on the icon pointed into the red color rectangle. The Android emulator displayed as below screen.



Step 9: Now, install Flutter and Dart plugin for building Flutter application in Android Studio. These plugins provide a template to create a Flutter application, give an option to run and debug Flutter application in the Android Studio itself. Do the following steps to install these plugins.

Step 9.1: Open the Android Studio and then go to File->Settings->Plugins.

Step 9.2: Now, search the Flutter plugin. If found, select Flutter plugin and click install. When you click on install, it will ask you to install Dart plugin as below screen. Click yes to proceed.



Step 9.3: Restart the Android Studio.

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Q-5 Explain Dart Syntax.

Answer:

- ❖ The purpose of Dart programming is to create a frontend user interfaces for the web and mobile apps.
- ❖ Dart is an open-source, general-purpose, object-oriented programming language with C-style syntax developed by **Google in 2011**.
- ❖ Its syntax has basically a blend of CPP, Python, Java, and JavaScript.
- ❖ Syntax defines a set of rules for writing programs.
- ❖ Every language specification defines its own syntax.
- ❖ A Dart program is composed of –
 - ✓ Variables and Operators
 - ✓ Classes
 - ✓ Functions
 - ✓ Expressions and Programming Constructs
 - ✓ Decision Making and Looping Constructs
 - ✓ Comments
 - ✓ Libraries and Packages
 - ✓ Typedefs
 - ✓ Data structures represented as Collections / Generics

Identifiers in Dart:

- ❖ Identifiers are the name given to variables that can be read by the compiler.
- ❖ There are certain rules to write the identifiers:
 - No special symbol can be used except _ and \$.
 - It can not be the reserved keywords.
 - There should not be any space between the variable name.
 - They are case sensitives.

Variables and Function in Dart:

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- ❖ Variables are the name given to a memory location declaring by writing variable-type _ name and then initialized and declared by " variable-type name = value;".

Example :- var name = 'John';

- ❖ Functions are another core feature of any programming language. Functions are a set of statements that performs a specific task.
- ❖ The function declaration contains the function name, return type, and parameters

Example :-.

/Function declaration

```
num addNumbers(num a, num b) {
```

```
    // Here, we use num as a type because it should work with int and double both.
```

```
    return a + b;
```

```
}
```

```
var price1 = 29.99;
```

Keywords in Dart:

- ❖ Keywords are the words that are used a dart to represent the basics syntax that the compiler will understand.
- ❖ The basic keywords that are used in dart programs are listed below:

import	else	as	abstract	switch	super	in
enum	assert	export	const	var	void	static
do	async	await	catch	on	null	new
class	break	continue	false	new	typedef	true
get	hide	set	show	dynamic	return	rethrow

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❖ Apart from this, there are other keywords that can be used as the syntax, but they
Are rarely used.

Comments in Dart

❖ A comment is a code snippet that is not readable by the compiler.
❖ Comments help to write a code efficiently and make it easier to understand the
code.

❖ Comments in dart can be obtained using one of the following:

' // ' is used to comment on a single line.

'/*.....*/' is used to comment on multiple lines.

Whitespace and Line Breaks

❖ Dart ignores spaces, tabs, and newlines that appear in programs.
❖ You can use spaces, tabs, and newlines freely in your program and you are free to format and indent your programs in a neat and consistent way that makes the
code easy to read and understand.

Dart is Case-sensitive

❖ Dart is case-sensitive.
❖ This means that Dart differentiates between uppercase and lowercase characters.

Statements end with a Semicolon

❖ Each line of instruction is called a statement.

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- ❖ Each dart statement must end with a semicolon (;).
- ❖ A single line can contain multiple statements.
- ❖ However, these statements must be separated by a semicolon.

Q-6 Explain How to write and execute first Dart Program.

Answer:

- ❖ The purpose of Dart programming is to create a frontend user interfaces for the web and mobile apps.
- ❖ It is under active development, compiled to native machine code for building mobile apps, inspired by other programming languages such as Java, JavaScript, C#, and is Strongly Typed.

Your First Dart Code

- ❖ Let us start with the traditional “Hello World” example :

```
main()
{
    print("Hello World!");
}
```

- ❖ The **main()** function is a predefined method in Dart.
- ❖ This method acts as the entry point to the application.
- ❖ A Dart script needs the **main()** method for execution.
- ❖ **print()** is a predefined function that prints the specified string or value to the standard output i.e. the terminal.
- ❖ The output of the above code will be –

Hello World!

Execute a Dart Program

- ❖ You can execute a Dart program in two ways –
 - Via the terminal

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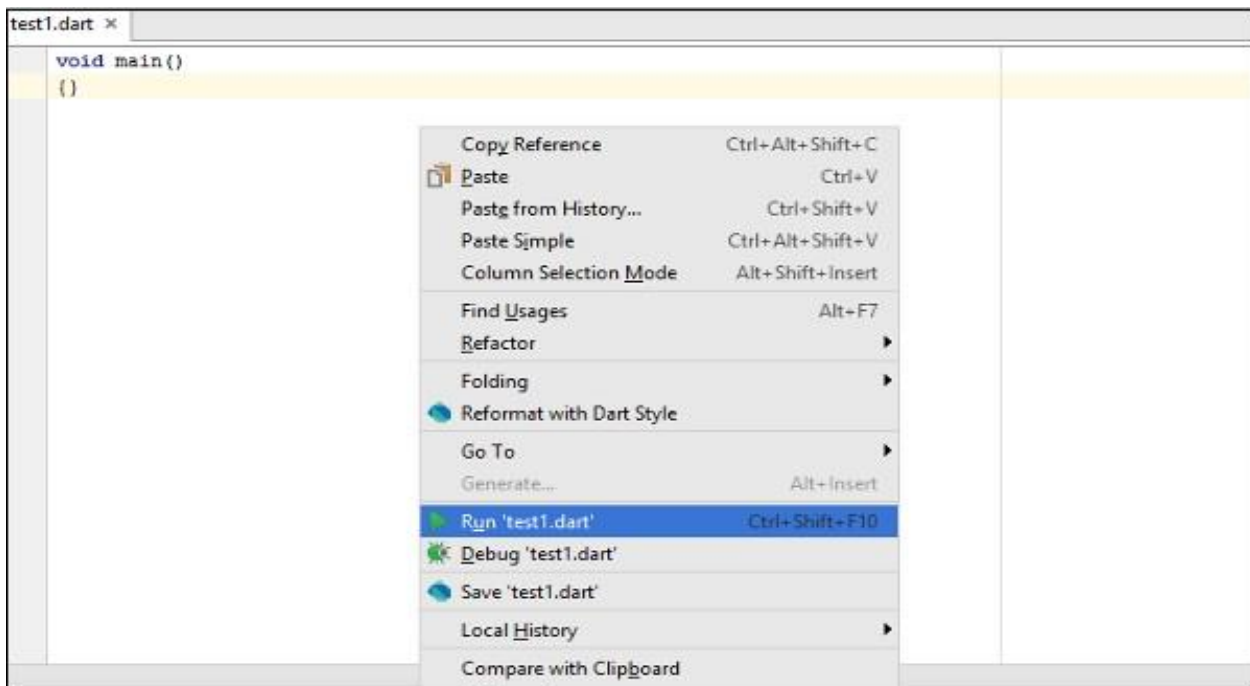
- Via the WebStorm IDE

Via the Terminal

- ❖ To execute a Dart program via the terminal –
 - Navigate to the path of the current project
 - Type the following command in the Terminal window
dart file_name.dart

Via the WebStorm IDE

- ❖ To execute a Dart program via the WebStorm IDE –
- ❖ Right-click the Dart script file on the IDE. (The file should contain the **main()** function to enable execution)
- ❖ Click on the '**Run <file_name>**' option. A screenshot of the same is given below –



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- ❖ One can alternatively click the  button or use the shortcut **Ctrl+Shift+F10** to execute the Dart Script.

Q-7 Explain Basic Data Types of Dart Programming.

Answer:

- ❖ Dart is a Strongly Typed programming language.
- ❖ It means, each value you use in your programming language has a type either string or number and must be known when the code is compiled.
- ❖ Here, are some most basic data types used in the Dart programming language.

✓ **String**

- A Dart string is a collection of characters and letters.
- You can use either single or double quotes to create a string.
- For multi-line string, we can use '....' or “.....”.
- We can give the value of a character inside a string by doing \$ {expression}.

Example :-

```
var name = 'John';
```

- Here a variable is called a name and the string is assigned a value “John”.

Note: If a variable is not initialized then the default value is null.

✓ **Numbers**

- Both int and double are can be used for the representation of numbers.
- These data types are used to represent any number and even a decimal.

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- The num type operates with basic algebraic operators.
Example :-

```
void main()
{
    int A = 20;
    double B = 30.0;
    print( A + B );
}
```

✓ Booleans

- In order to use the Boolean data types, dart uses the keyword named bool.
- These data types have two values that are True and False.

Example :-

```
void main()
{
    bool isIttrue1 = true;
    print('$isIttrue1');
}
```

✓ Collection [List, Set, Maps]

- Collections in Dart is basically a collection of similar and different data types.
- These are used as data structures in dart. Each element can be accessed sequentially.

Example :-

```
void main()
{
    var list = [10, 20, 30];
    var names = ['abc','jkl', 10, 1];
}
```

Q-8 Explain Flutter Widgets.

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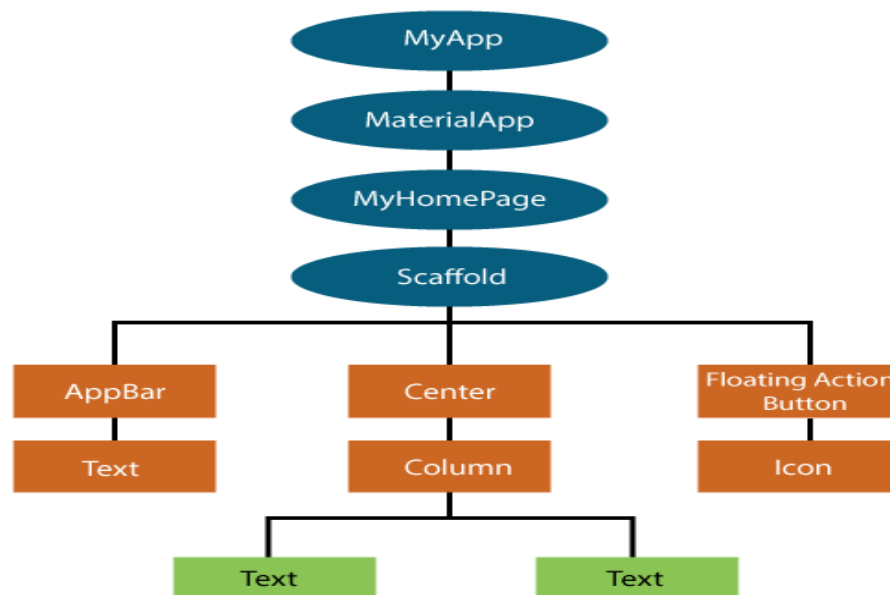


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Answer:

- ❖ It describes how your app view should look like with their current configuration and state.
- ❖ The central purpose is to build the app out of widgets.
- ❖ Widgets are nested with each other to build the app. It means the root of your app is itself a widget.
- ❖ For example, a widget can display something, can define design, can handle interaction, etc.
- ❖ The below image is a simple visual representation of the widget tree.



Types of Widget

We can split the Flutter widget into two categories:

1. Visible (Output and Input)
2. Invisible (Layout and Control)

Visible widget

- ❖ The visible widgets are related to the user input and output data.
- ❖ Some of the important types of this widget are:

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Text

- ✓ A Text widget holds some text to display on the screen.
- ✓ We can align the text widget by using **textAlign** property, and style property allow the customization of Text that includes font, font weight, font style, letter spacing, color, and many more.

```
new Text(  
  'Hello, Javatpoint!',  
  textAlign: TextAlign.center,  
  style: new TextStyle(fontWeight: FontWeight.bold),  
)
```

Button

- ✓ This widget allows you to perform some action on click.
- ✓ Flutter does not allow you to use the Button widget directly; instead, it uses a type of buttons like a **FlatButton** and a **RaisedButton**.

```
//FlatButton Example  
new FlatButton(  
  child: Text("Click here"),  
  onPressed: () {  
    // Do something here  
  },  
)
```

Image

- ✓ This widget holds the image which can fetch it from multiple sources like from the asset folder or directly from the URL.
- ✓ It provides many constructors for loading image, which are given below:

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- **Image:** It is a generic image loader, which is used by **ImageProvider**.
- **asset:** It load image from your project asset folder.
- **file:** It loads images from the system folder.
- **memory:** It load image from memory.
- **network:** It loads images from the network.

Icon

- ✓ This widget acts as a container for storing the Icon in the Flutter.
- ✓ The following code explains it more clearly.

```
new Icon(  
  Icons.add,  
  size: 34.0,  
)
```

Invisible widget

- ✓ The invisible widgets are related to the layout and control of widgets.
- ✓ It provides controlling how the widgets actually behave and how they will look onto the screen.
- ✓ Some of the important types of these widgets are:

Column

- ✓ A column widget is a type of widget that arranges all its children's widgets in a vertical alignment.
- ✓ It provides spacing between the widgets by using the **mainAxisAlignment** and **crossAxisAlignment** properties.
- ✓ In these properties, the main axis is the vertical axis, and the cross axis is the horizontal axis.

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Example

```
new Column(  
  mainAxisAlignment: MainAxisAlignment.center,  
  children: <Widget>[  
    new Text(  
      "VegElement",  
    ),  
    new Text(  
      "Non-vegElement"  
    ),  
  ],  
)
```

Row

- ✓ The row widget is similar to the column widget, but it constructs a widget horizontally rather than vertically.
- ✓ Here, the main axis is the horizontal axis, and the cross axis is the vertical axis.

Example

The below code snippets construct two widget elements horizontally.

```
new Row(  
  mainAxisAlignment: MainAxisAlignment.spaceEvenly,  
  children: <Widget>[  
    new Text(  
      "VegElement",  
    ),  
    new Text(  

```

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"Non-vegElement"

),
],
)

Center

- ✓ This widget is used to center the child widget, which comes inside it.
- ✓ All the previous examples contain inside the center widget.

Example

```
Center(  
  child: new Column(  
    mainAxisAlignment: MainAxisAlignment.spaceEvenly,  
    children: <Widget>[  
      new Text(  
        "VegElement",  
      ),  
      new Text(  
        "Non-vegElement"  
      ),  
    ],  
  ),  
)
```

Padding

- ✓ This widget wraps other widgets to give them padding in specified directions.
- ✓ You can also provide padding in all directions.
- ✓ We can understand it from the below example that gives the text widget padding of 6.0 in all directions.

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Example

```
Padding(  
  padding: const EdgeInsets.all(6.0),  
  child: new Text(  
    "Element 1",  
  ),  
)
```

State Management Widget

In Flutter, there are mainly two types of widget:

- StatelessWidget
- StatefulWidget

StatefulWidget

- ✓ A StatefulWidget has state information.
- ✓ It contains mainly two classes: the **state object** and the **widget**.
- ✓ It is dynamic because it can change the inner data during the widget lifetime.
- ✓ This widget does not have a **build()** method.
- ✓ It has **createState()** method, which returns a class that extends the Flutter's State Class. The examples of the StatefulWidget are Checkbox, Radio, Slider, InkWell, Form, and TextField.

Example

```
class Car extends StatefulWidget {  
  const Car({ Key key, this.title }) : super(key: key);  
  
  @override  
  _CarState createState() => _CarState();  
}
```

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}

```
class _CarState extends State<Car> {  
  @override  
  Widget build(BuildContext context) {  
    return Container(  
      color: const Color(0xFEEFE),  
      child: Container(  
        child: Container( //child: Container() )  
      )  
    );  
  }  
}
```

StatelessWidget

- ✓ The StatelessWidget does not have any state information
- ✓ . It remains static throughout its lifecycle.
- ✓ The examples of the StatelessWidget are Text, Row, Column, Container, etc.

Example

```
class MyStatelessCarWidget extends StatelessWidget {  
  const MyStatelessCarWidget ({ Key key }) : super(key: key);  
  
  @override  
  Widget build(BuildContext context) {  
    return Container(color: const Color(0x0xFEEFE));  
  }  
}
```

Q-9 Explain Flutter Layouts.

Answer:

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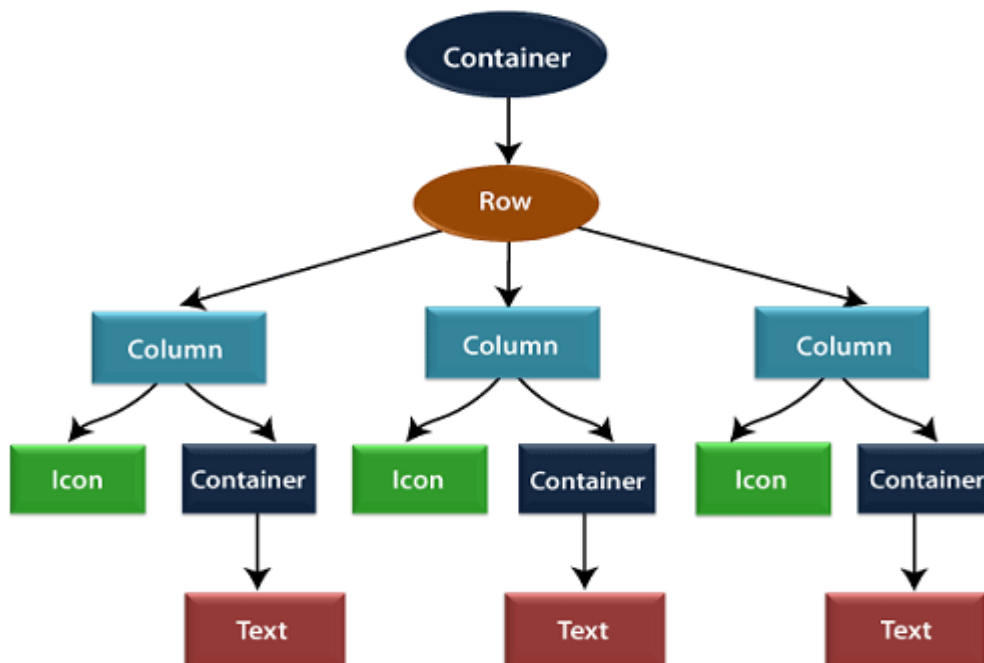
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- ❖ The main concept of the layout mechanism is the widget.
- ❖ We know that flutter assume everything as a widget. So the image, icon, text, and even the layout of your app are all widgets.
- ❖ Here, some of the things you do not see on your app UI, such as rows, columns, and grids that arrange, constrain, and align the visible widgets are also the widgets.
- ❖ Flutter allows us to create a layout by composing multiple widgets to build more complex widgets.
- ❖ **For example**, we can see the below image that shows three icons with a label under each one.



- ❖ In the second image, we can see the visual layout of the above image.
- ❖ This image shows a row of three columns, and these columns contain an icon and label.



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- ❖ In the above image, the **container** is a widget class that allows us to customize the child widget.
- ❖ It is mainly used to add borders, padding, margins, background color, and many more.
- ❖ Here, the text widget comes under the container for adding margins.
- ❖ The entire row is also placed in a container for adding margin and padding around the row.
- ❖ Also, the rest of the UI is controlled by properties such as color, text.style, etc.

Layout a widget

- ❖ Following steps show how to layout a widget:

Step 1: First, you need to select a Layout widget.

Step 2: Next, create a visible widget.

Step 3: Then, add the visible widget to the layout widget.

Step 4: Finally, add the layout widget to the page where you want to display.

Types of Layout Widgets

- ❖ We can categories the layout widget into two types:

1. Single Child Widget
2. Multiple Child Widget

Single Child Widgets

- ❖ The single child layout widget is a type of widget, which can have only **one child widget** inside the parent layout widget.
- ❖ These widgets can also contain special layout functionality.
- ❖ Flutter provides us many single child widgets to make the app UI attractive.

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- ❖ If we use these widgets appropriately, it can save our time and makes the app code more readable.
- ❖ The list of different types of single child widgets are:

Container:

- ✓ It is the most popular layout widget that provides customizable options for painting, positioning, and sizing of widgets.

```
Center(  
  child: Container(  
    margin: const EdgeInsets.all(15.0),  
    color: Colors.blue,  
    width: 42.0,  
    height: 42.0,  
  ),  
)
```

Padding:

- ✓ It is a widget that is used to arrange its child widget by the given padding.
- ✓ It contains **EdgeInsets** and **EdgeInsets.fromLTRB** for the desired side where you want to provide padding.

```
const Greetings(  
  child: Padding(  
    padding: EdgeInsets.all(14.0),  
    child: Text('Hello JavaTpoint!'),  
  ),  
)
```

Center:

- ✓ This widget allows you to center the child widget within itself.

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▪ Align:

- It is a widget, which aligns its child widget within itself and sizes it based on the child's size.
- It provides more control to place the child widget in the exact position where you need it.

```
Center(  
  child: Container(  
    height: 110.0,  
    width: 110.0,  
    color: Colors.blue,  
    child: Align(  
      alignment: Alignment.topLeft,  
      child: FlutterLogo(  
        size: 50,  
      ),  
    ),  
  ),  
)
```

SizedBox:

- ✓ This widget allows you to give the specified size to the child widget through all screens.

```
SizedBox(  
  width: 300.0,  
  height: 450.0,  
  child: const Card(child: Text('Hello JavaTpoint!')),  
)
```

▪ AspectRatio:

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- This widget allows you to keep the size of the child widget to a specified aspect ratio.

```
AspectRatio(  
  aspectRatio: 5/3,  
  child: Container(  
    color: Colors.blue,  
  ),  
)
```

Baseline:

- ✓ This widget shifts the child widget according to the child's baseline.

```
child: Baseline(  
  baseline: 30.0,  
  baselineType: TextBaseline.alphabetic,  
  child: Container(  
    height: 60,  
    width: 50,  
    color: Colors.blue,  
  ),  
)
```

ConstrainedBox:

- ✓ It is a widget that allows you to force the additional constraints on its child widget.
- ✓ It means you can force the child widget to have a specific constraint without changing the properties of the child widget.

```
ConstrainedBox(  
  constraints: new BoxConstraints(  
    width: 100,  
    height: 100,  
  ),  
  child: Container(  
    width: 50,  
    height: 50,  
    color: Colors.red,  
  ),  
)
```


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"Sky is the Limit"

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```
// This is the theme of your application.
primarySwatch: Colors.green,
),
home: MyHomePage(),
);
}
}

class MyHomePage extends StatelessWidget {

  @override
  Widget build(BuildContext context) {
    return Scaffold(
      appBar: AppBar(title: Text("FittedBox Widget")),
      body: Center(
        child: FittedBox(child: Row(
          children: <Widget>[
            Container(
              child: Image.asset('assets/computer.png'),
            ),
            Container(
              child: Text("This is a widget"),
            )
          ]
        )
      )
    );
  }
}
```

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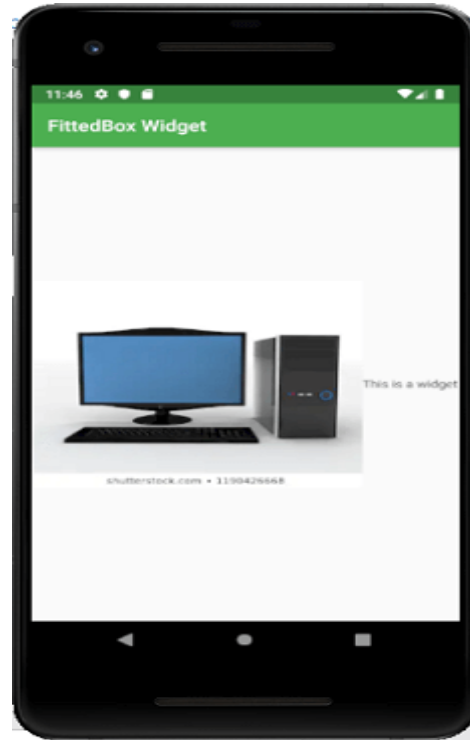


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```
    ],  
    ),  
    fit: BoxFit.contain,  
  )  
),  
);  
}  
}
```

Output



Q-10 Explain Basic Properties of Flutter Widgets.

Answer:

- ❖ Properties are variables of any type defined on the class.
- ❖ Here are list of some common properties of Flutter Widgets.

(1) Alignment Property

Specifies the widget alignment in a box. A widget can be aligned *top-left*, *top-center*, *top-right*, *middle-left*, *middle-center*, *middle-right*, *bottom-left*, *bottom-center*, or *bottom-right*.

NOTE: This property is not supported on [Browser](#), [DataGrid](#), [Map](#), [PickerView](#), [Segment](#) and [Slider](#) widgets.

NOTE: The alignment property is applicable only if the widget size is lesser than the allocated size.

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(2) Expand Property (horizontal and vertical)

Specifies the widget expansion in the horizontal and vertical direction.

NOTE: This property is not supported on [Browser](#), [Image](#), [Map](#), [PickerView](#) widgets.

The Expand property provides you with the following options:

horizontal

Specifies if the widget must expand horizontally.

Default: *true* (the checkbox is selected and the widget occupies the entire available width)

If you set the value to *false* (clear the checkbox), the widget occupies the preferred width.

Vertical

Specifies if the widget must expand vertically.

Default: *false* (the checkbox is not selected and the widget occupies the preferred height)

If you set the value to *true* (select the checkbox), the widget occupies the entire available height.

(3) Focus Skin Property

This is a skin property and it determines the look and feel when there is focus on a widget.

For more information on how to create and work with skins, see the *Working with Applications* section of the *Quantum Visualizer User Guide*.

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NOTE:

1. Mobile Web does not support this property. For Advanced Mobile Web platforms, a platform specific progress indicator is displayed. For other Mobile Web platforms (Basic and BJS), the screen is refreshed.
2. For the Pickerview widget on Android, borders, font weight, font size, and font style are ignored.

```
frm1.btn1.focusSkin="skin1";
```

Accessible from IDE

Yes

Availability on platforms

The following table shows the list of available platforms and property availability:

(4) ID Property

Defines a string of alpha numeric characters that uniquely identifies a widget within an application.

Type

String

Read/Write

Yes (Read-only access)

Example If you want to access a widget with ID *widget1* in a Form whose ID is *frm1*, enter the following:

```
var idcheck = frm1.widget1.id;  
kony.print ("widget1 id is :"+idcheck);
```

Accessible from IDE

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Yes

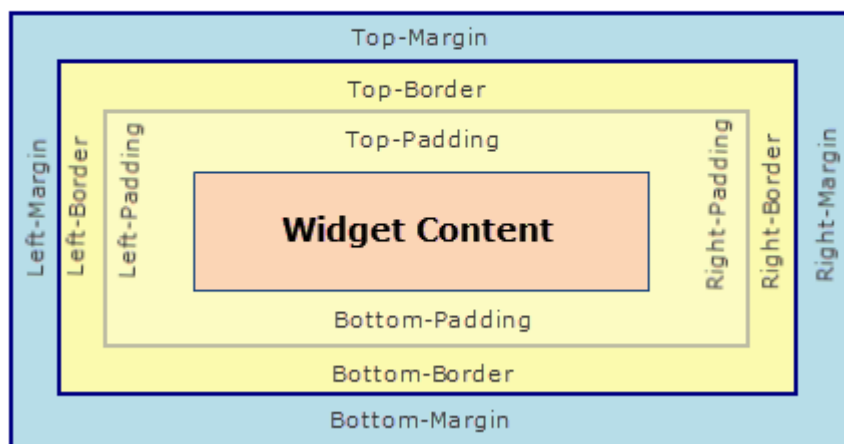
(5) Margin Property

Defines the space around a widget. You can use this option to define the top, left, right, and bottom distance between the widget and the next element.

If you want to use the margin values set for a platform across other platforms, you can click the *Apply To* button and select the platforms on which you want the margin values to be applied.

The following image illustrates a widget with a defined margin:

Margin



Type

Number

(6) Padding Property

Defines the space between the content of the widget and the widget boundaries. You can use this option to define the top, left, right, and bottom distance between the widget content and the widget boundary.

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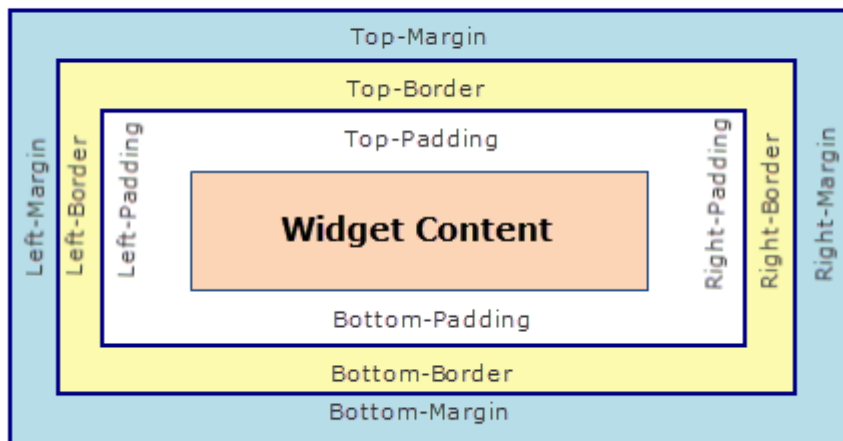
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NOTE: Note: If no skin is applied to a Button, then Padding is not supported on iPhone. This is due to iOS Safari browser limitation. If you want the padding to be applied, apply a skin to the button and then apply padding.

The following image illustrates a widget with a defined padding:

Padding



Type

Number

(7) Render Property

Specifies if the widget code must be included in the platform when the code is generated. You can use the *Render* property to specify the platforms on which the widget will not be available.

By default, the *Render* property includes all the platforms. You must explicitly clear the check box against the platforms that you want to exclude.

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NOTE: Note: When two widgets are placed side by side in an HBox, and you exclude one widget from code generation, the widget which is rendered respects its container weight and does not expand.

Type

String

(8) Text Property

Specifies a general or descriptive text for the widget.

Type

String

Read/Write

Yes (Read and Write)

To set the text of a widget with ID *widget1* on a form *frm1* enter the following code:

```
frm1.widget1.text="sample text";
```

Accessible from IDE

Yes

(9) Title Property

Specifies a general or descriptive text for the widget.

Type

String

Read/Write

No

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Accessible from IDE

Yes

(10) isVisibleProperty

Specifies the visibility of the widget.

Default: *true* (the checkbox is selected)

If you do not want the widget to be visible, set the value to *false* (clear the checkbox).

NOTE: This property is not applicable if the widget is placed in a [Segment](#). When the widget is placed in a Segment, the default *Visibility* is set to *true*. If you want to change the value to *false*, you can do so using the [Segment Methods](#).

Type

Boolean

Q-11 Explain Dart Libraries and Packages.

Answer:

- ❖ In Dart, the library is the collection of the routine or set of programming instructions.
- ❖ Dart consists of many sets of built-in libraries that are beneficial to hold routines (functions, set of classes, etc.), and regularly used.
- ❖ A Dart library contains constants, functions, properties, exceptions, and typedefs, and set of classes.
- ❖ To work with the library, we must import it into the current program.
- ❖ The Dart provides the import **keyword**, which is used to make the library available in the current file. We can use multiple libraries in a single file.
- ❖ For example - Dart built-in library URIs is used as dart scheme to refer to a library.
- ❖ Other libraries can use a file system path or the package: scheme to specify its URIs.

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- ❖ The package manager pub in Dart provides the libraries and uses the package scheme.
- ❖ We are describing some commonly used libraries below.

Sr.	Library	Description
1.	dart:io	This library consists of File, HTTP, socket, and other I/O support for server applications. This library is not suitable for browser-based applications. We don't need to import explicitly because it is imported by default.
2.	Dart:core	This library consists of Collection, built-in types, and other core functionality for each dart program. It is imported by default.
3.	Dart: math	This library consists of the rich mathematical functions, constant, and random number generator.
4.	Dart: convert	It is used to Encoders and decoders for converting the different data representations such as JSON and UTF
5.	Dart: typed_data	It represents the lists that store the fixed-sized data efficiently (for example - unsigned 8-byte integer).

- ❖ Let's understand the following example of importing and using a library function.

Example - Importing and using a Library

```
1. import 'dart:math'; // Importing built-in library
2. void main() {
3.   print("Square root of 36 is: ${sqrt(36)}");
4. }
```

Output:

Square root of 25 is: 5.0

Explanation:

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- ❖ In the above code, we imported the built-in library '**dart:math**'.
- ❖ It provides the many built-in mathematical function, here we used the **sqrt()** function with number.

✓ Dart Packages

- ❖ Dart package is the collection of a well-organized, independent, and reusable code unit.
- ❖ Applications might be needed to implement third-party libraries or packages.
- ❖ The package generally contains a set of classes, functions, or unit of code for specific tasks along with the compiled program and sample data. Dart provides an extensive set of default packages that load automatically when the dart console starts.
- ❖ However, if we need packages other than the default packages then its need to installed and loaded explicitly in order to use.
- ❖ When a package is loaded, it can be used in the whole Dart environment.

✓ Dart Package Manager

- ❖ Every language provides the functionality for handling the external packages such as **Nuget** for .NET, **Gradle or Maven** for Java, **npm** for Node.js, etc.
- ❖ Dart has the inbuilt package manager, which is called a **pub**.
- ❖ It is basically used to organize, manage the third-party libraries, tools, dependencies, and also used to install the packages in the repository.
- ❖ Every Dart application consists of a **pubspec.yaml** file which includes the metadata of the file.
- ❖ The metadata of the package holds the author, version, application name, and description.
- ❖ The full form of the yaml is a **Yet Another Markup Language**. The **pubspec.yaml** is used to download the various libraries that application needs during programming.
- ❖ The Dart IDE's provides the inbuilt support for using the pub that consist of creating, downloading, updating, and publishing packages, Otherwise we can use the pub command line. The following is the list of the few important **pub commands**.

Sr. No	Description
--------	-------------

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pub get	It is used to get all packages of application dependent on.
pub upgrade	It is used to upgrade all application dependencies to the modern version.
pub build	It is used to construct your web application, and it will create a build folder, with all related scripts in it.
pub help	It is used to get help related to all pub commands or when we stuck while programming.

✓ Installing a Package

- ❖ The following steps are defining the installation of the package in the project.

Backward Skip 10sPlay VideoForward Skip 10s

- ❖ Step - 1: Write the package name in the dependencies section of project's pubspec.yaml file. Then run the below command to find the package installed in project.

1. **pub get**

- ❖ The above command will download the package under the packages folder in the application directory.

Example -

1. name: TestApp
2. version: 0.0.1
3. description: A simple dart application
4. dependencies:
5. xml:

- ❖ We have added the xml to the project dependencies.

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❖ Now we can use Dart XML package in the project by importing it. It can be imported as follows.

1. **import 'package:xml/xml.dart'** as xml;
Read XML String

- ❖ We can read XML string and authenticate the input; Dart XML provides a parse() method to read the string input.
- ❖ The syntax is given below.

1. **xml.parse(String input):**

Q-12 Explain control flow and loops in Dart.

Answer:

- ❖ The **control statements** or **flow of control statements** are used to control the flow of Dart program.
- ❖ These statements are very important in any programming languages to decide whether other statement will be executed or not.
- ❖ The code statement generally runs in the sequential manner.
- ❖ We may require executing or skipping some group of statements based on the given condition, jumps to another statement, or repeat the execution of the statements.
- ❖ In Dart, control statement allows to smooth flow of the program. By using the control flow statements, a Dart program can be altered, redirected, or repeated based on the application logic.

✓ Categories of Flow Statement

- ❖ In Dart, Control flow statement can be categorized mainly in three following ways.
 - Decision-making statements
 - Looping statements
 - Jump statements

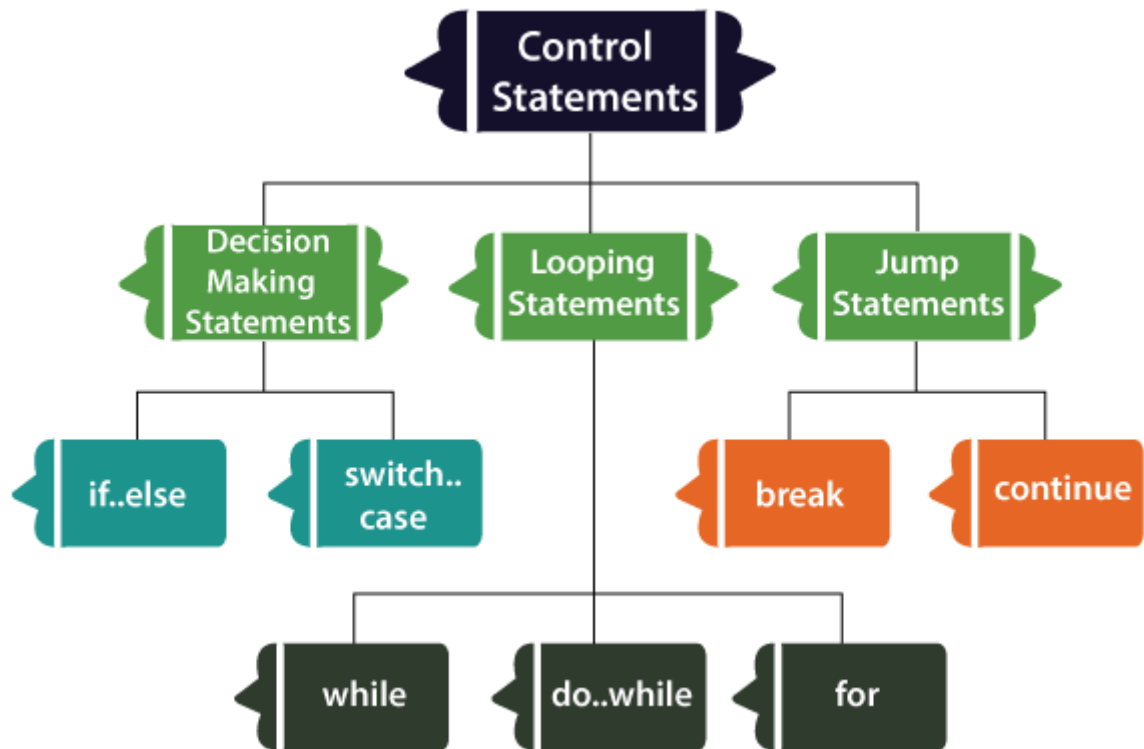
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❖ Dart provides following types of Decision-making statement.

- If Statement
- If-else Statements
- If else if Statement
- Switch Case Statement

✓ Dart if Statements

- If statement allows us to a block of code execute when the given condition returns true
- . In Dart programming, we have a scenario where we want to execute a block of code when it satisfies the given condition.

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- The condition evaluates Boolean values TRUE or FALSE and the decision is made based on these Boolean values.

Syntax :

1. If (condition) {
2. //statement(s)
3. }

- The given condition is if statement will evaluate either TRUE or FALSE, if it evaluates true then statement inside if body is executed, if it evaluates false then statement outside if block is executed.
- Let's understand the following example.

Example - 1

1. **void** main () {
2. // define a variable which hold numeric value
3. var n = 35;
- 4.
5. // if statement check the given condition
6. **if** (n<40){
7. print("The number is smaller than 40")
8. };
9. }

Output:

The number is smaller than 40

✓ Dart if-else Statement

- In Dart, if-block is executed when the given condition is true.
- If the given condition is false, else-block is executed.

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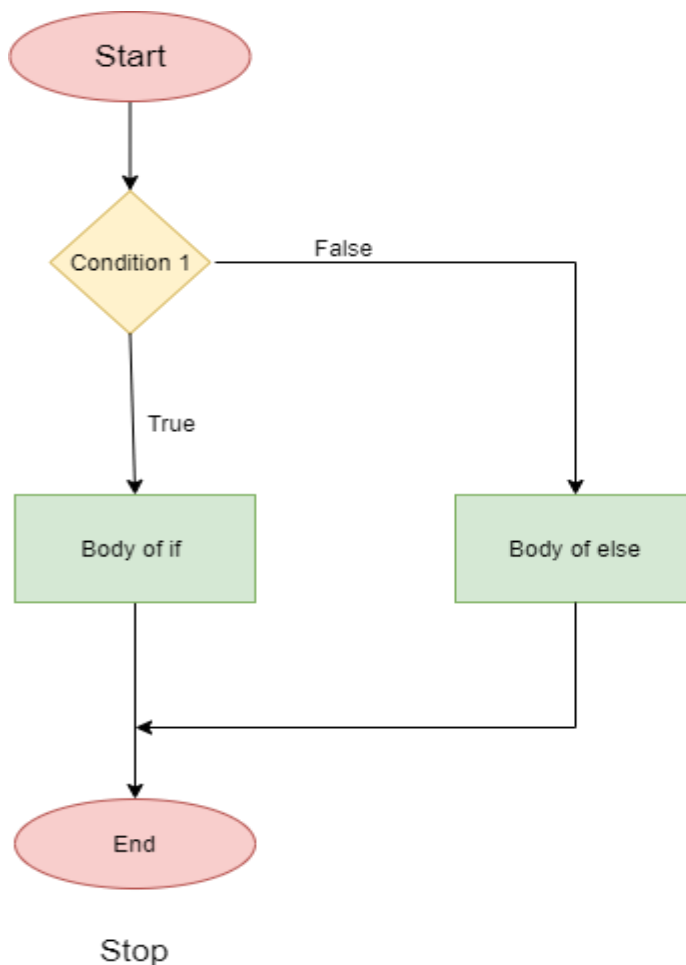


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- The else block is associated with the if-block.

Dart if...else Statement Flow Diagram



Syntax:

```
1.  if(condition) {
2.      // statement(s);
3.  } else {
4.      // statement(s);
5.  }
```

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- Here, if -else statement is used for either types of result TRUE or False.
- If the given condition evaluates true, then if body is executed and if the given condition evaluates false; then, the else body is executed.

Let's understand the following example.

Example -

```
1. void main() {  
2.     var x = 20;  
3.     var y = 30;  
4.     print("if-else statement example");  
5.  
6.     if(x > y){  
7.         print("x is greater than y");  
8.     } else {  
9.         print("y is greater than x");  
10.  
11.};  
12.  
13.}
```

Output:

if-else statement example
y is greater than x

Dart if else-if Statement

- Dart if else-if statement provides the facility to check a set of test expressions and execute the different statements.
- It is used when we have to make a decision from more than two possibilities.

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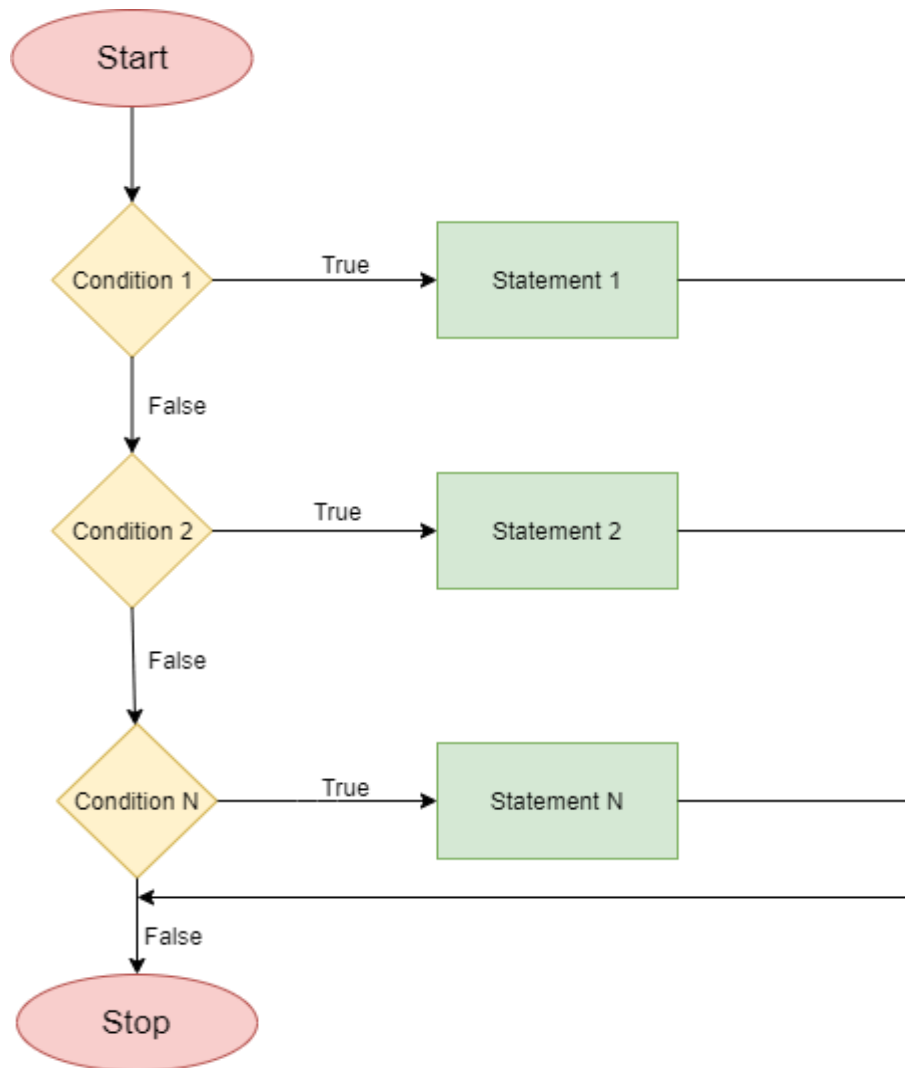
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Dart if else if Statement Flow Diagram



Syntax

1. **if** (condition1) {
2. // statement(s)
3. }
4. **else if**(condition2) {
5. // statement(s)
6. }

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```
7.  else if (conditionN) {  
8.      // statement(s)  
9.  }  
10. .  
11. .  
12. else {  
13.     // statement(s)  
14. }
```

- Here, this type of structure is also known as the else....if ladder.
- The condition is evaluated from top to bottom.
- Whenever it found the true condition, statement associated with that condition is executed.
- When all the given condition evaluates false, then the else block is executed.

Let's understand the following example.

Example - Write a program to print the result based on the student's marks.

```
1. void main() {  
2.   var marks = 74;  
3.   if(marks > 85)  
4.   {  
5.       print("Excellent");  
6.   }  
7.   else if(marks>75)  
8.   {  
9.       print("Very Good");  
10.  }  
11.  else if(marks>65)  
12.  {  
13.      print("Good");  
14.  }
```

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```
15.else
16. {
17.     print("Average");
18. }
19. }
```

Output:

Average

✓ Dart Switch Case Statement

- Dart Switch case statement is used to avoid the long chain of the if-else statement.
- It is the simplified form of nested if-else statement.
- The value of the variable compares with the multiple cases, and if a match is found, then it executes a block of statement associated with that particular case.
- The assigned value is compared with each case until the match is found. Once the match found, it identifies the block of code to be executed.

Dart Switch Case Statement Flowchart

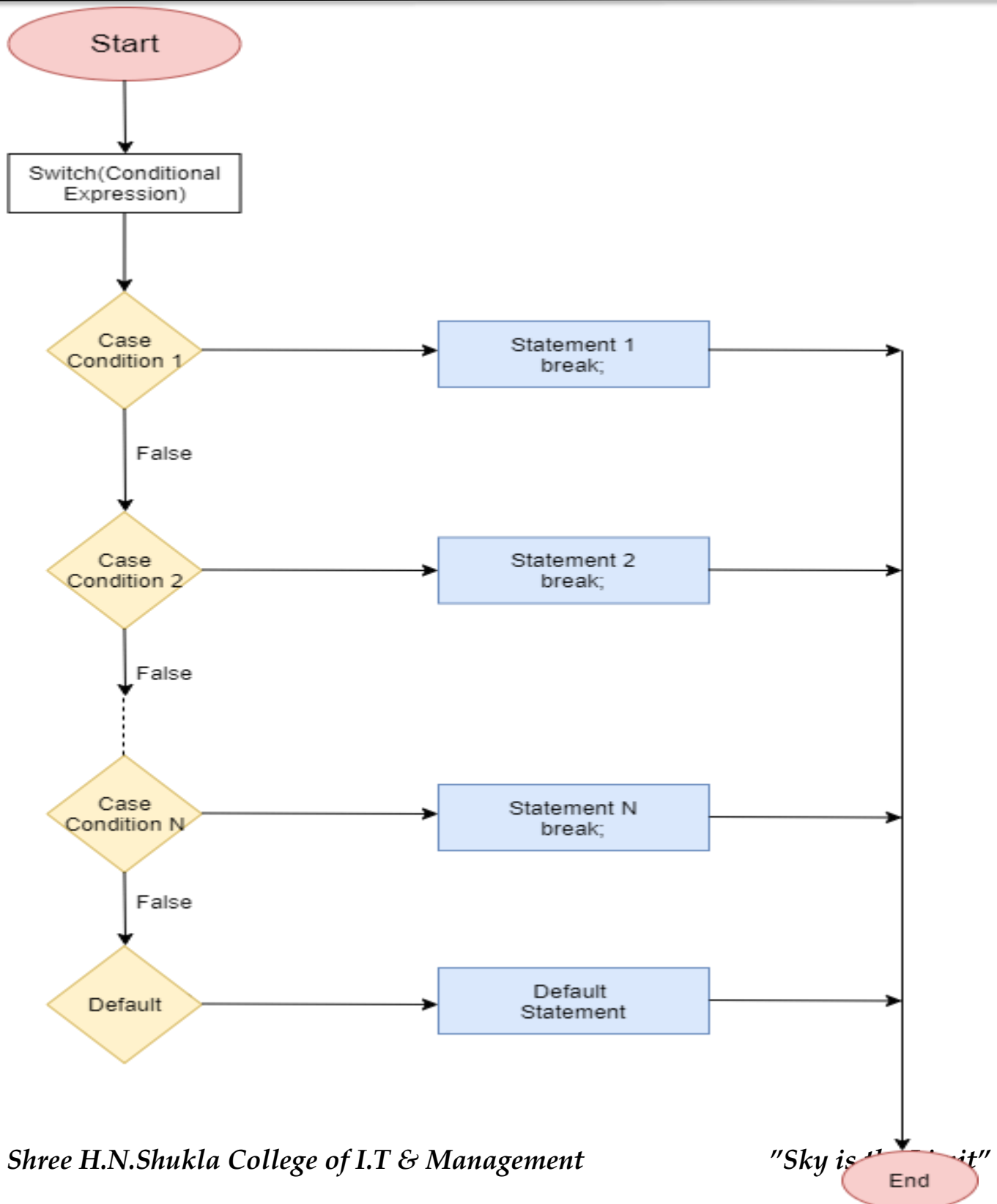
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Syntax:

```
1. switch( expression )
2. {
3.     case value-1:{
4.
5.         //statement(s)
6.         Block-1;
7.     }
8.     break;
9.     case value-2:{
10.
11.         //statement(s)
12.         Block-2;
13.     }
14.     break;
15.     case value-N:{
16.
17.         //statement(s)
18.         Block-N;
19.     }
20.     break;
21.     default: {
22.         //statement(s);
23.     }
24. }
```

- Here, the expression can be integer expression or character expression.
- The value 1, 2, n represents the case labels and they are used to identify each case particularly.
- Each label must be ended with the colon(:).
- The labels must be unique because same name label will create the problem while running the program.
- A block is associated with the case label. Block is nothing but a group of multiple statements for a particular case.

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- Once the switch expression is evaluated, the expression value is compared with all cases which we have defined inside the switch case.
- Suppose the value of the expression is 2, then compared with each case until it found the label 2 in the program.
- The **break statement** is essential to use at the end of each case.
- If we do not put the break statement, then even the specific case is found, it will execute all the cases until the program end is reached.
- The **break** keyword is used to declare the break statement.
- Sometimes the value of the expression is not matched with any of the cases; then the default case will be executed. It is optional to write in the program.

Let's understand the following example.

```
1.    void main() {  
2.        int n = 3;  
3.        switch (n) {  
4.            case 1:  
5.                print("Value is 1");  
6.                break;  
7.            case 2:  
8.                print("Value is 2");  
9.                break;  
10.           case 3:  
11.               print("Value is 3");  
12.               break;  
13.           case 4:  
14.               print("Value is 4");  
15.               break;  
16.           default:  
17.               print("Out of range");  
18.               break;  
19.        }
```

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20. }

Output:

Value is 3

✓ **Dart Loops**

- Dart Loop is used to run a block of code repetitively for a given number of times or until matches the specified condition.
- Loops are essential tools for any programming language.
- It is used to iterate the Dart iterable such as list, map, etc. and perform operations for multiple times.
- A loop can have two parts - a body of the loop and control statements.
- The main objective of the loop is to run the code multiple times.
- Dart supports the following type of loops.
 - Dart for loop
 - Dart for...in loop
 - Dart while loop
 - Dart do-while loop
- We describe a brief introduction to the dart loops as follows.

(1)Dart for loop

- The for loop is used when we know how many times a block of code will execute.
- It is quite same as the C for loop. The syntax is given below.

Syntax :

1. **for**(Initialization; condition; incr/decr) {
2. // loop body
3. }

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- The loop iteration starts from the initial value. It executes only once.
- The condition is a test-expression and it is checked after each iteration.
- The for loop will execute until false returned by the given condition.
- The incr/decr is the counter to increase or decrease the value.

Let's understand the following example.

Example -

```
1. void main()
2. {
3.     int num = 1;
4.     for(num; num<=10; num++)    //for loop to print 1-10 numbers
5.     {
6.         print(num);    //to print the number
7.     }
8. }
```

Output:

1
2
3
4
5
6
7
8
9
10

(2) Dart for... in Loop

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- The for...in loop is slightly different from the for loop.
- It only takes dart object or expression as an iterator and iterates the element one at a time.
- The value of the element is bound to var, which is and valid and available for the loop body.
- The loop will execute until no element left in the iterator. The syntax is given below.

Syntax :

1. **for** (var in expression) {
2. *//statement(s)*
3. }

Example :

1. **void** main()
2. {
3. var list1 = [10,20,30,40,50];
4. **for**(var i in list1) *//for..in loop to print list element*
5. {
6. print(i); *//to print the number*
7. }
8. }

Output:

10
20
30
40
50

- We need to declare the iterator variable to get the element from the iterator.

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(3) Dart while loop

- The while loop executes a block of code until the given expression is false.
- It is more beneficial when we don't know the number of execution. The syntax is given below.

Syntax:

1. **while**(condition) {
2. // loop body
3. }

Let's understand the following example.

Example -

1. **void** main()
2. {
3. var a = 1;
4. var maxnum = 10;
5. **while**(a<maxnum){ // it will print until the expression return false
6. print(a);
7. a = a+1; // increase value 1 after each iteration
8. }
9. }

Output:

- 1
- 2
- 3
- 4

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5
6
7
8
9

(4) Dart do...while Loop

- The do...while loop is similar to the while loop but only difference is that, it executes the loop statement and then check the given condition.
- The syntax is given below.

Syntax :

```
1. do {  
2.    // loop body  
3. } while(condition);
```

Example :

```
1. void main()  
2. {  
3.   var a = 1;  
4.   var maxnum = 5;  
5.   do  
6.   {  
7.     print("The value is: ${a}");  
8.     a = a+1;  
9.   }while(a<maxnum);  
10. }
```

Output:

The value is: 1
The value is: 2
The value is: 3
The value is: 4