TINKERING
LAB MANUAL

B. TECH
III YEAR – I SEM (R23)
(2025-26)

DEPARTMENT OF CSE-AIML

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Syllabus

1. a) Install Flutter and Dart SDK
   b) Write a simple Dart program to understand the language basics
   c) Write a Dart console program that prints your name, checks age with conditionals, uses a loop to count from 1 to 5, and defines a function to return the sum of two numbers.
2. a) Explore various Flutter widgets (Text, Image, Container, etc.).
   b) Implement different layout structures using Row, Column, and Stack widgets.
   c) Create a Flutter app with a Text widget showing a counter value, and an ElevatedButton that increments the counter using setState() .
3. a) Design a responsive UI that adapts to different screen sizes.
   b) Implement media queries and breakpoints for responsiveness.
4. a) Set up navigation between different screens using Navigator.
   b) Implement navigation with named routes.
5. a) Learn about stateful and stateless widgets.
   b) Implement state management using set State and Provider.
6. a) Create custom widgets for specific UI elements.
   b) Apply styling using themes and custom styles.
7. a) Design a form with various input fields.
   b) Implement form validation and error handling.
8. a) Add animations to UI elements using Flutter's animation framework.
   b) Experiment with different types of animations (fade, slide, etc.).
9. a) Fetch data from a REST API.
   b) Display the fetched data in a meaningful way in the UI.
10. a) Write unit tests for UI components.
    b) Use Flutter's debugging tools to identify and fix issues.

1. a) Install Flutter and Dart SDK.

AIM: To install Flutter and the Dart SDK, you can follow these steps:

a) Download Flutter: Visit the Flutter website's Get Started page and download the Flutter SDK for your operating system (Windows, macOS, or Linux).

b) Extract the Flutter SDK: After downloading, extract the contents of the compressed file to a location on your computer where you want to store the Flutter SDK. For example, you can extract it to C:\flutter on Windows, /Users/<your-username>/flutter on macOS, or ~/flutter on Linux.

c) Add Flutter to your PATH: Update your system's PATH variable to include the Flutter bin
directory. This step allows you to execute Flutter commands from any directory in your terminal or command prompt. The precise steps for updating the PATH vary depending on your operating system.

Windows: From the Start search bar, type 'env' and select 'Edit the system environment
variables'. Click on 'Environment Variables'. Under 'System Variables', find the 'Path' variable, select it, and click 'Edit'. Click 'New' and add the path to the bin directory insidethe Flutter directory (e.g., C:\flutter\bin). Click 'OK' on all open dialogs to save your changes.

macOS and Linux: Open a terminal window.
Run the following command to open the profile file associated with your terminal (.bash_profile, .bashrc, .zshrc, or similar):
nano ~/.bash_profile Add the following line at the end of the file:
export PATH="$PATH:/path/to/flutter/bin"
Press Ctrl + X to exit, then Y to save changes, and Enter to confirm.

d) Verify the Flutter installation: Open a new terminal window, and run the following command to verify that Flutter is properly installed: flutter –version. This comman should display the Flutter version and other relevant information if the installation was successful.

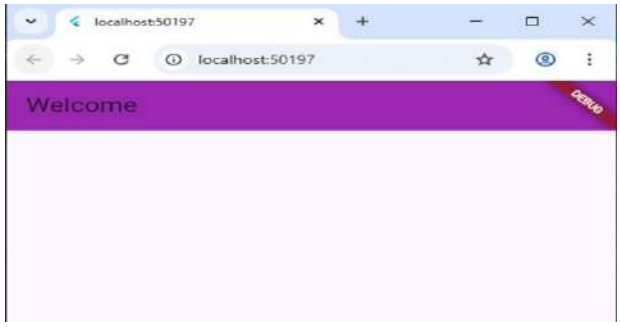
e) Install Flutter dependencies: Depending on your development environment, you may need to install additional dependencies, such as Android Studio to fully set up your Flutter development environment.

f) Download Dart SDK (if not bundled with Flutter): Flutter comes with the Dart SDK bundled, so if you've installed Flutter, you should have the Dart SDK as well. However, if you need to install Dart separately, you can download it from the Dart "SDK archive".

b) Write a simple dart program to understand the language basics.

```
import 'package:flutter/material.dart';
void main() {
  runApp(Abc());
}
class Abc extends StatelessWidget {
  @override
  Widget build(BuildContext context) {
    return MaterialApp(
      home: Def(),
    );
  }
}
class Def extends StatelessWidget {
  const Def({super.key});
@override
  Widget build(BuildContext context) {
    return Scaffold(
      appBar: AppBar(
        title: Text("Welcome"),
        backgroundColor: Colors.purple,
      ),
      body: Column(
        children: [
          //Widgets
        ],
      ),
    );
  }
}
```

OUTPUT:



1.c) Write a Dart console program that prints your name, checks age with conditionals, uses a loop to count from 1 to 5, and defines a function to return the sum of two numbers.

PROGRAM:

```
int addNumbers(int a, int b) {
  return a + b;
}
void main() {
  // 1. Print your name
  String name = "Chandini"; // you can replace with your own name
  print("My name is $name");

  // 2. Check age with conditionals
  int age = 22; // change value to test
  if (age >= 18) {
    print("You are an adult.");
  } else {
    print("You are a minor.");
  }

  // 3. Loop to count from 1 to 5
  print("Counting from 1 to 5:");
  for (int i = 1; i <= 5; i++) {
    print(i);
  }

  // 4. Use the sum function
  int x = 10, y = 20;
  int result = addNumbers(x, y);
  print("The sum of $x and $y is $result");
}
```

OUTPUT:

```
My name is Chandini
You are an adult.
Counting from 1 to 5:
1
2
3
4
5
The sum of 10 and 20 is 30
```

2. a) Explore various Flutter widgets (Text, Image, Container, etc.).

Description:

Flutter provides a rich set of widgets to build user interfaces for mobile, web, and desktop applications. These widgets help in creating visually appealing and interactive UIs. Here are

some of the commonly used Flutter widgets categorized by their functionalities:

Layout Widgets:

Container: A versatile widget that can contain other widgets and provides options for alignment, padding, margin, and decoration.

Row and Column: Widgets that arrange their children in a horizontal or vertical line respectively.

Stack: Allows widgets to be stacked on top of each other, enabling complex layouts.

ListView and GridView: Widgets for displaying a scrollable list or grid of children, with support for various layouts and scrolling directions.

Scaffold: Implements the basic material design layout structure, providing app bars, drawers, and floating action buttons.

Text and Styling Widgets:

Text: Displays a string of text with options for styling such as font size, color, and alignment.

RichText: Allows for more complex text styling and formatting, including different styles within the same text span.

TextStyle: A class for defining text styles that can be applied to Text widgets.

Input Widgets:

TextField: A widget for accepting user input as text, with options for customization and validation.

Checkbox and Radio: Widgets for selecting from a list of options, either through checkboxes or radio buttons.

DropdownButton: Provides a dropdown menu for selecting from a list of options.

Button Widgets:

ElevatedButton and TextButton: Widgets for displaying buttons with different styles and customization options.

IconButton: A button widget that displays an icon and responds to user taps.

GestureDetector: A versatile widget that detects gestures such as taps, swipes, and drags, allowing for custom interactions.

Image and Icon Widgets:

Image: Widget for displaying images from various sources, including assets, network URLs, and memory.

Icon: Displays a Material Design icon.

Navigation Widgets:

Navigator: Manages a stack of route objects and transitions between different screens or pages in the app.

PageRouteBuilder: A customizable widget for building page transitions and animations.

Animation Widgets:

AnimatedContainer: An animated version of the Container widget, with support for transitioning properties over a specified duration.

AnimatedOpacity, AnimatedPositioned, AnimatedBuilder: Widgets for animating opacity, position,and custom properties respectively.

Material Design Widgets:

AppBar: A material design app bar that typically contains a title, leading and trailing widgets, and actions.

BottomNavigationBar: Provides a navigation bar at the bottom of the screen for switching betwee different screens or tabs.

Card: Displays content organized in a card-like structure with optional elevation and padding.

Cupertino (iOS-style) Widgets:

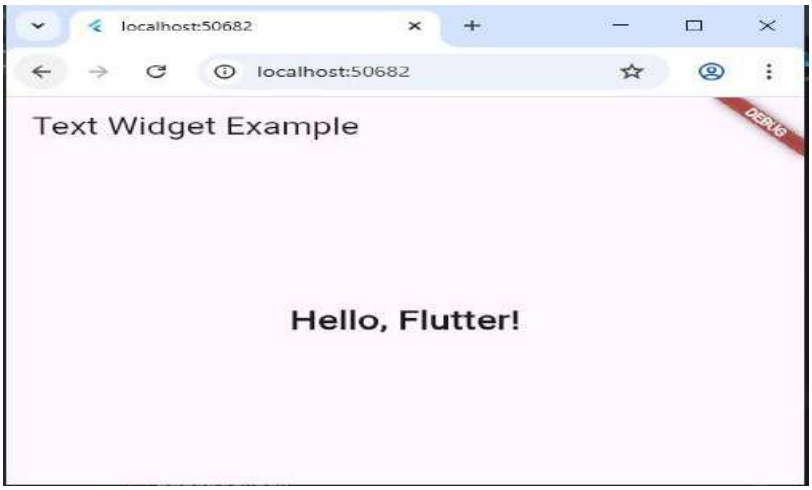
CupertinoNavigationBar: A navigation bar in the iOS style. CupertinoButton: A button widget with the iOS style.

CupertinoTextField: A text fieldwidget with the iOS style. These are just a few examples of the many widgets available in Flutter. Each widget comes with its set of properties and customization options, allowing developers to create highly customizable and responsive user interfaces.

PROGRAM: TEXT

```
import 'package:flutter/material.dart';
void main() {
  runApp(MyApp());
}
class MyApp extends StatelessWidget {
@override
Widget build(BuildContext context) {
  return MaterialApp(
      home: Abc()
  );
}
}
class Abc extends StatelessWidget {
const Abc({super.key});
@override
Widget build(BuildContext context) {
  return Scaffold(
      appBar: AppBar(title: Text('Text Widget Example')),
body: Center(
          child: Text(
            'Hello, Flutter!',
            style: TextStyle(fontSize: 24, fontWeight: FontWeight.bold),
          ),
      ),
  );
}
}
```

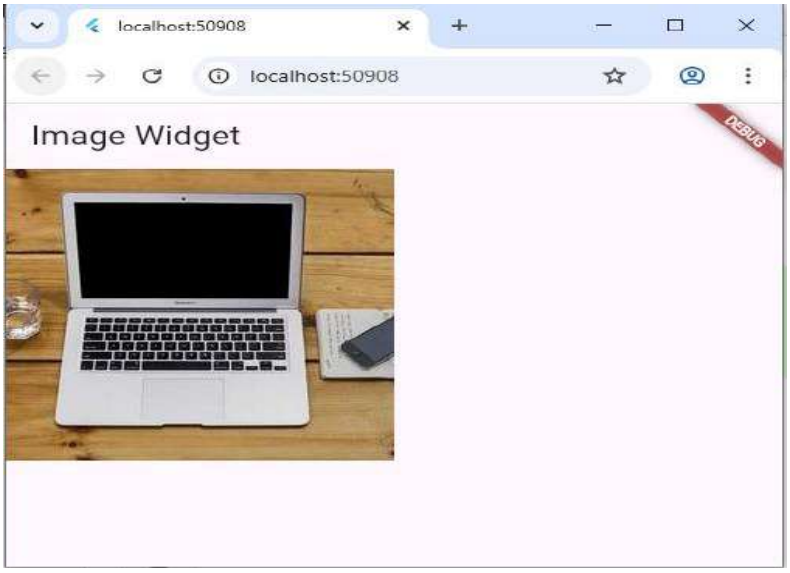
OUTPUT:



PROGRAM: IMAGE

```
import 'package:flutter/material.dart';
void main() {
  runApp(MyApp());
}
class MyApp extends StatelessWidget {
@override
Widget build(BuildContext context) {
  return MaterialApp(
    home: Abc(),
  );
}
}
class Abc extends StatelessWidget {
const Abc({super.key});
@override
Widget build(BuildContext context) {
  return Scaffold(
    appBar: AppBar(
      title: Text("Image Widget"),
    ),
    body: Image.network('https://picsum.photos/250?image=9'),
  );
}
}
```

OUTPUT:

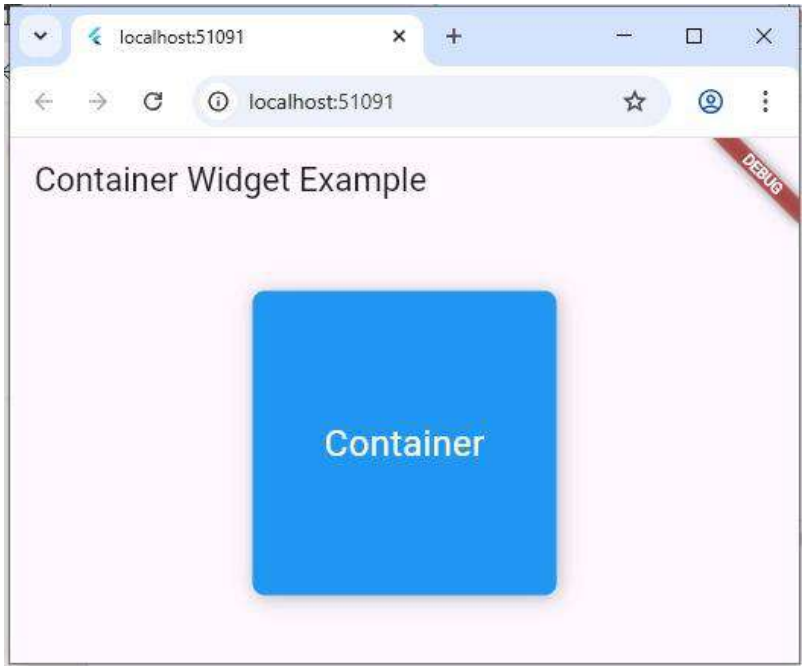


PROGRAM: CONTAINER

```
import 'package:flutter/material.dart';
void main() {
  runApp(MyApp());
}
class MyApp extends StatelessWidget {
@override
Widget build(BuildContext context) {
  return MaterialApp(
    home: Abc(),
  );
}
}
class Abc extends StatelessWidget {
const Abc({super.key});
@override
Widget build(BuildContext context) {
  return Scaffold(
    appBar: AppBar(title: Text('Container Widget Example')),
    body: Center(
      child: Container(
        width: 200,
        height: 200,
        padding: EdgeInsets.all(16),
        margin: EdgeInsets.all(16),
        decoration: BoxDecoration(
          color: Colors.blue,
          borderRadius: BorderRadius.circular(8),
          boxShadow: [
            BoxShadow(
              color: Colors.black26,

              blurRadius: 10,
              offset: Offset(2, 2),
            ),
          ],
        ),
        child: Center(
          child: Text(
            'Container',
            style: TextStyle(color: Colors.white, fontSize: 24),
          ),
```

```
        ),
      ),
    ),
  );
}
}
```

OUTPUT:

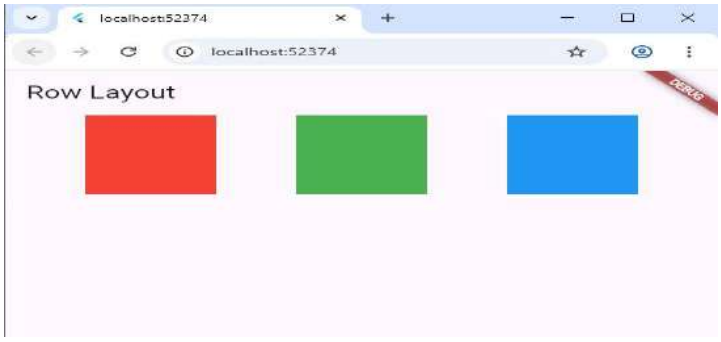

localhost:51091
localhost:51091
Container Widget Example
DEBUG
Container

2) b) Implement different layout structures using Row, Column, and Stack widgets.

PROGRAM: ROW WIDETS.

```
import 'package:flutter/material.dart';
void main() {
  runApp(MyApp());
}
class MyApp extends StatelessWidget {
@override
Widget build(BuildContext context) {
  return MaterialApp( home:
  Scaffold(appBar: AppBar(
    title: Text('Row Layout'),
  ),
    body: Row(
      mainAxisAlignment: MainAxisAlignment.spaceEvenly, children:
    <Widget>[
      Container(
        color: Colors.red,
        width: 100, height: 100,
      ), Container(
      color: Colors.green,
      width: 100, height: 100,
    ),
      Container(
        color: Colors.blue, width: 100,
        height: 100,
      ),
    ],
    ),
  ),
  );
}
}
```

OUTPUT:



PROGRAM: COLUMN WIDETS.

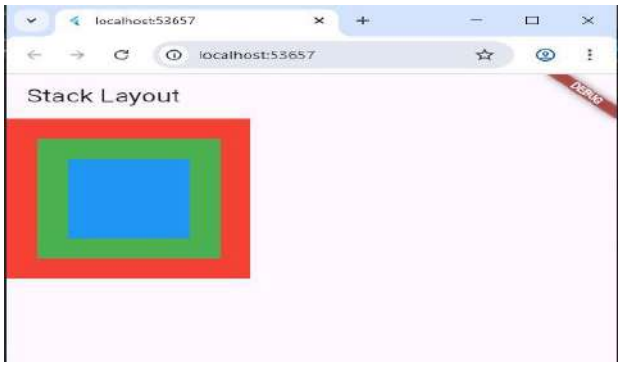
```
import 'package:flutter/material.dart';
void main() {
  runApp(MyApp());
}
class MyApp extends StatelessWidget {
@override
Widget build(BuildContext context) {
  return MaterialApp( home:
  Scaffold(appBar: AppBar(
    title: Text('Column Layout'),
  ),
    body: Column(
      mainAxisAlignment: MainAxisAlignment.spaceEvenly, children:
    <Widget>[
      Container(
        color: Colors.red, width: 100,
        height: 100,
      ), Container(
      color: Colors.green, width: 100,
      height: 100,
    ), Container(
      color: Colors.blue, width: 100,
      height: 100,
    ),
    ],
    ),
  ),
  );
}
}
```

OUTPUT:

PROGRAM: STACK WIDETS.

```
import 'package:flutter/material.dart';
void main() {
  runApp(MyApp());}
class MyApp extends StatelessWidget {
@override
Widget build(BuildContext context) {
  return MaterialApp( home:
  Scaffold(appBar: AppBar(
    title: Text('Stack Layout'),
  ),
    body: Stack(
      alignment: Alignment.center, children:
    <Widget>[
      Container(
        color: Colors.red, width: 200,
        height: 200,
      ),
      Container(
        color: Colors.green, width: 150,
        height: 150,
      ), Container(
      color: Colors.blue, width: 100,
      height: 100,
    ),
    ],
    ),
  ),
  ) ;
}  }
```

OUTPUT:



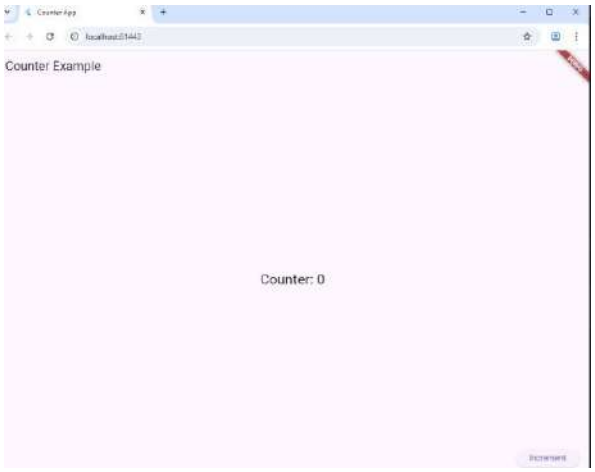
2. c) create a flutter app with a text widget showing a counter value, and an ElevatedButton that increments the counter using setState().

PROGRAM:

```
 import 'package:flutter/material.dart';

void main() {
  runApp(MyApp());
}

class MyApp extends StatelessWidget {
  @override
  Widget build(BuildContext context) {
    return MaterialApp(
      title: 'Counter App',
      home: CounterScreen(),
    );
  }
}

class CounterScreen extends StatefulWidget {
  @override
  _CounterScreenState createState() => _CounterScreenState();
}

class _CounterScreenState extends State<CounterScreen> {
  int _counter = 0;

  void _incrementCounter() {
    setState(() {
      _counter++; // increment the counter
    });
  }

  @override
  Widget build(BuildContext context) {
    return Scaffold(
      appBar: AppBar(
        title: Text('Counter Example'),
```

```
      ),
      body: Center(
        child: Text(
          'Counter: $_counter',
          style: TextStyle(fontSize: 24),
        ),
      ),
      floatingActionButton: ElevatedButton(
        onPressed: _incrementCounter,
        child: Text('Increment'),
      ),
    );
  }
}
```

OUTPUT:



3. a) Design a responsive UI that adapts to different screen sizes.

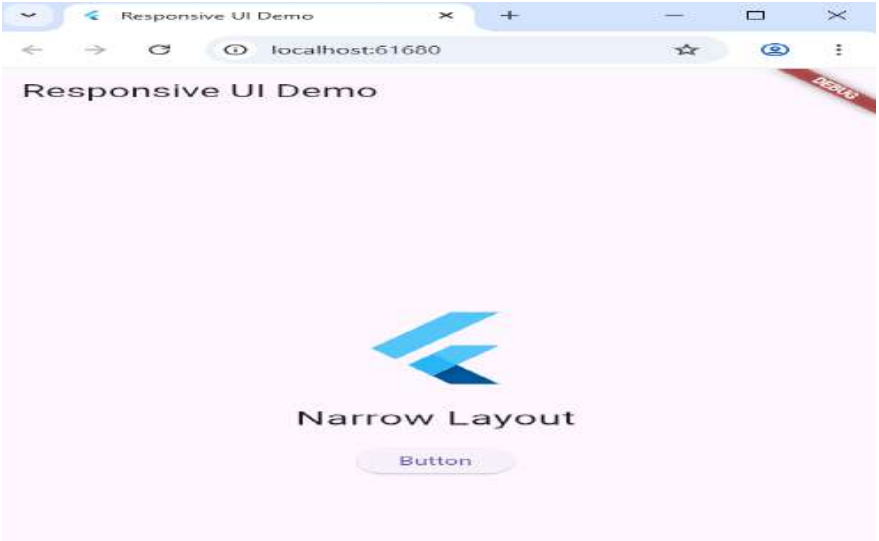
PROGRAM:

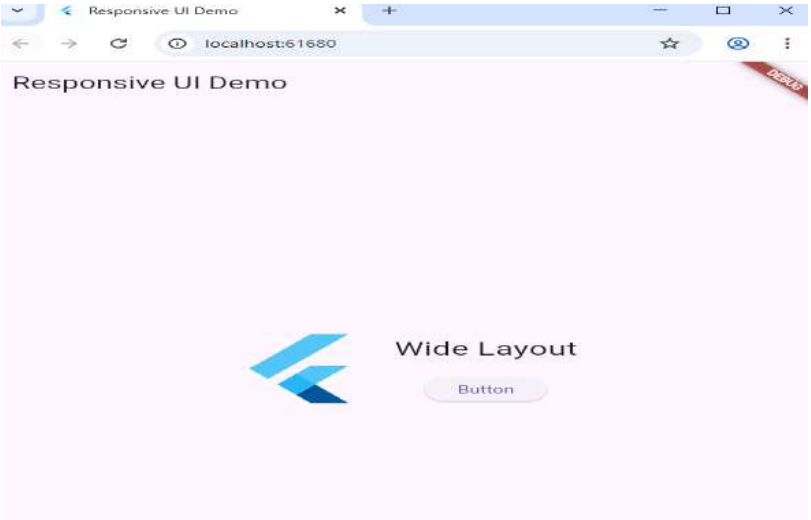
```
import 'package:flutter/material.dart';
void main() {
  runApp(MyApp());
}
class MyApp extends StatelessWidget {
  @override
  Widget build(BuildContext context) {
    return MaterialApp(
      title: 'Responsive UI Demo', theme:
    ThemeData( primarySwatch:
    Colors.blue,
    ),
      home: ResponsiveHomePage(),
    );
  }
}
class ResponsiveHomePage extends StatelessWidget {
  @override
  Widget build(BuildContext context) {
    return Scaffold(
      appBar: AppBar(
        title: Text('Responsive UI Demo'),
      ),
      body: LayoutBuilder(
        builder: (BuildContext context, BoxConstraints constraints) {
          if (constraints.maxWidth < 600) {
            return _buildNarrowLayout();
          } else {
            return _buildWideLayout();
          }
        },
      ),
    );
  }
  Widget _buildNarrowLayout() {
    return Center(
```

```
      child: Column(
      mainAxisAlignment: MainAxisAlignment.center, children:
      <Widget>[
      FlutterLogo(size: 100),
  SizedBox(height: 20), Text(
  'Narrow Layout',
  style: TextStyle(fontSize: 24),
  ),
        SizedBox(height: 20),
        ElevatedButton( onPressed:
          () {},
         child: Text('Button'),
        ),
      ],
      ),
  );
}
Widget _buildWideLayout() {
  return Center(
    child: Row(
      mainAxisAlignment: MainAxisAlignment.center,
      children: <Widget>[
        FlutterLogo(size: 100),
        SizedBox(width: 20),
        Column(
          mainAxisAlignment: MainAxisAlignment.center,
          children: <Widget>[
            Text(
              'Wide Layout',
              style: TextStyle(fontSize: 24),
            ),
            SizedBox(height: 20),
            ElevatedButton( onPressed: ()
            {},
              child: Text('Button'),
            ),
          ],
        ),
```

```
        ],
      ),
    );
  }
}
```

OUTPUT:


Responsive UI Demo
localhost:61680
Responsive UI Demo
DEBUG
Narrow Layout
Button


Responsive UI Demo
localhost:61680
Responsive UI Demo
DEBUG
Wide Layout
Button

3. b) Implement media queries and breakpoints for responsiveness.

PROGRAM:

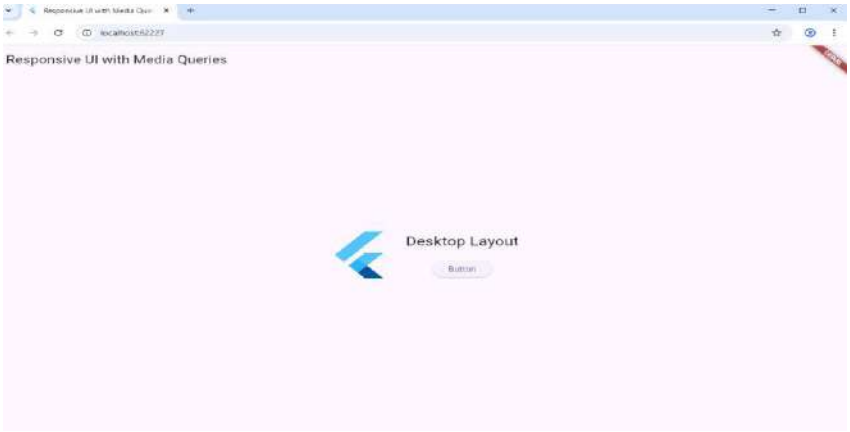
```
import 'package:flutter/material.dart';
void main() {
  runApp(MyApp());
}
class MyApp extends
StatelessWidget {
  @override
  Widget build(BuildContext
  context) {
    return MaterialApp(
      title: 'Responsive UI with Media Queries', theme: ThemeData(
      primarySwatch: Colors.blue,
    ),
      home:
      ResponsiveHomePage(),
    );
  }
}
class ResponsiveHomePage extends
StatelessWidget {
  @override
  Widget build(BuildContext context) {
    return
      Scaffold(
        appBar: AppBar(
          title: Text('Responsive UI with Media Queries'),
        ),
        body: LayoutBuilder(
          builder: (BuildContext context, BoxConstraints constraints) {
            if (constraints.maxWidth < 600) {
              return _buildMobileLayout();
            } else if (constraints.maxWidth < 1200) {
              return _buildTabletLayout();
            } else {
              return _buildDesktopLayout();
            }
```

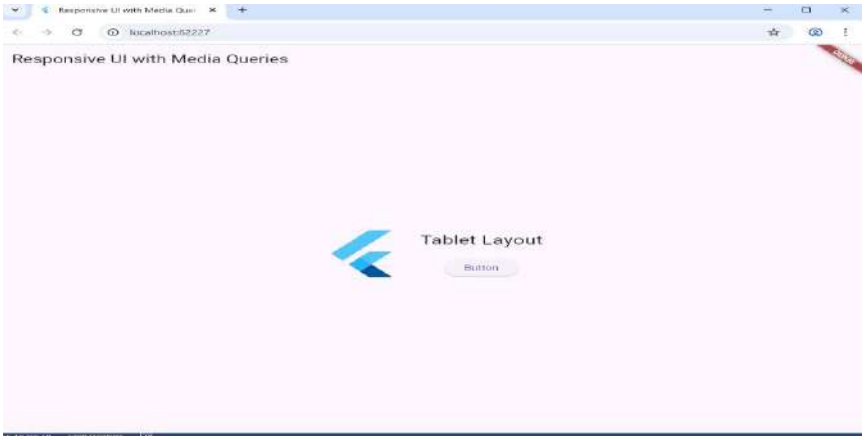
```
        },
      ),
    );
  }
  Widget _buildMobileLayout() {
    return Center(
      child: Column(
        mainAxisAlignment: MainAxisAlignment.center,
        children: <Widget>[
          FlutterLogo(size: 100),
          SizedBox(height: 20),
          Text(
            'Mobile Layout',
            style: TextStyle(fontSize: 24),
          ),
          SizedBox(height: 20),
          ElevatedButton(
            onPressed: () {},
            child: Text('Button'),
          ),
        ],
      ),
    );
  }
  Widget
  _buildTabletLayout() {
    return
      Center(
        child:
        Row(
          mainAxisAlignment: MainAxisAlignment.center,
          children: <Widget>[
            FlutterLogo(size: 100),
            SizedBox(width: 20),
            Column(
              mainAxisAlignment: MainAxisAlignment.center,
              children: <Widget>[
                Text(
                  'Tablet Layout',
```

```
              style: TextStyle(fontSize: 24),
            ),
            SizedBox(height: 20),
            ElevatedButton(
              onPressed: () {},
              child: Text('Button'),
            ),
          ],
        ),
      ],
    ),
  );
}
Widget _buildDesktopLayout() {
  return
    Center(
      child: Row(
        mainAxisAlignment: MainAxisAlignment.center,
        children: <Widget>[
          FlutterLogo(size: 100),
          SizedBox(width: 20),
          Column(
            mainAxisAlignment: MainAxisAlignment.center,
            children: <Widget>[
              Text(
                'Desktop Layout',
                style: TextStyle(fontSize: 24),
              ),
              SizedBox(height: 20),
              ElevatedButton(
                onPressed: () {},
                child: Text('Button'),
              ),
            ],
          ),
        ],
      ),
    );
```

```
}
}
```

OUTPUT:


Responsive UI with Media Queries
Desktop Layout
Button


Responsive UI with Media Queries
Tablet Layout
Button


Responsive UI with Media Queries
Mobile Layout
Button

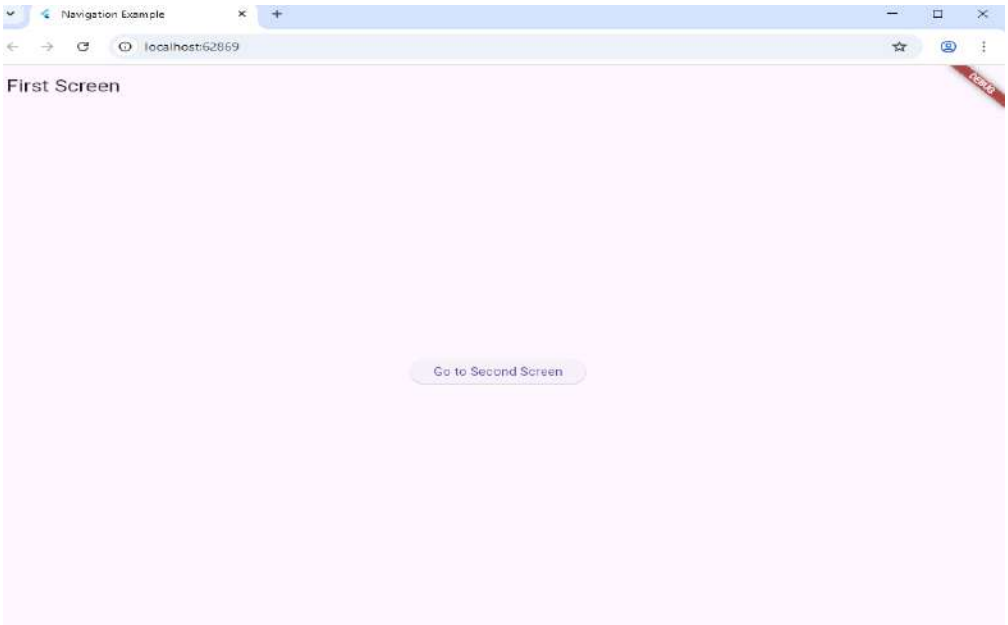
4. a) Setup navigation between different screens using navigator

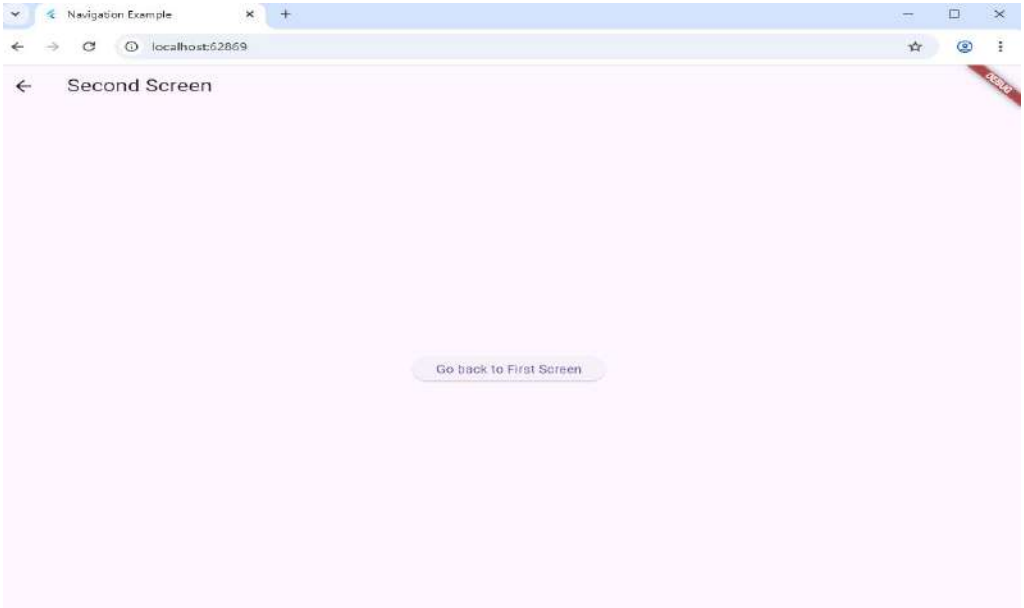
PROGRAM:

```
import 'package:flutter/material.dart';
void main() {
runApp(MyApp());
}
class MyApp extends StatelessWidget {
@override
Widget build(BuildContext context) {
return MaterialApp(
title: 'Navigation Example',
theme: ThemeData(
primarySwatch: Colors.blue,
),
home: FirstScreen(),
);
}
}
class FirstScreen extends StatelessWidget {
@override
Widget build(BuildContext context) {
return Scaffold(
appBar: AppBar(
title: Text('First Screen'),
),
body: Center(
child: ElevatedButton(
onPressed: () {
// Navigate to the second screen
Navigator.push(
context,
MaterialPageRoute(builder: (context) => SecondScreen()),
);
},
child: Text('Go to Second Screen'),
),
),
);
}
```

```
}

class SecondScreen extends StatelessWidget {
@override
Widget build(BuildContext context) {
return Scaffold(
appBar: AppBar(
title: Text('Second Screen'),
),
body: Center(
child: ElevatedButton(
onPressed: () {
// Navigate back to the first screen
Navigator.pop(context);
},
child: Text('Go back to First Screen'),
),
),
);
}
}
```

OUTPUT:


Navigation Example
localhost:62869
First Screen
DEBUG
Go to Second Screen


Navigation Example
localhost:62869
Second Screen
DEBUG
Go back to First Screen

4.b) Implement navigation with named routes

PROGRAM:

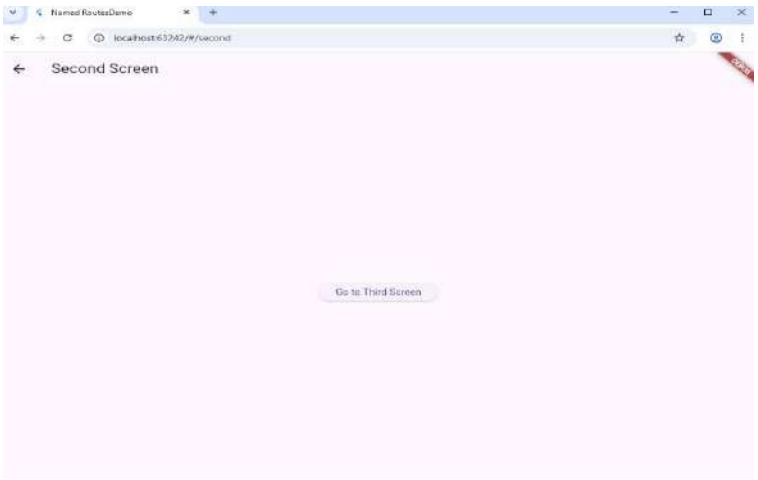
```
import 'package:flutter/material.dart';
void main() {
  runApp(MyApp());
}
class MyApp extends
StatelessWidget {
  @override
  Widget build(BuildContext
  context) {
    return MaterialApp(
      title: 'Named RoutesDemo',
      initialRoute: '/',
      routes: {
        '/': (context) => HomeScreen(),
        '/second': (context) => SecondScreen(),
        '/third': (context) => ThirdScreen(),
      },
    );
  }
}
class HomeScreen extends StatelessWidget {
  @override
  Widget build(BuildContext context) {
    return
      Scaffold(
        appBar: AppBar(
          title: Text('Home Screen'),
        ),
        body: Center(
          child: ElevatedButton(
            onPressed: () {
              Navigator.pushNamed(context, '/second');
            },
            child: Text('Go to Second Screen'),
          ),
        ),
```

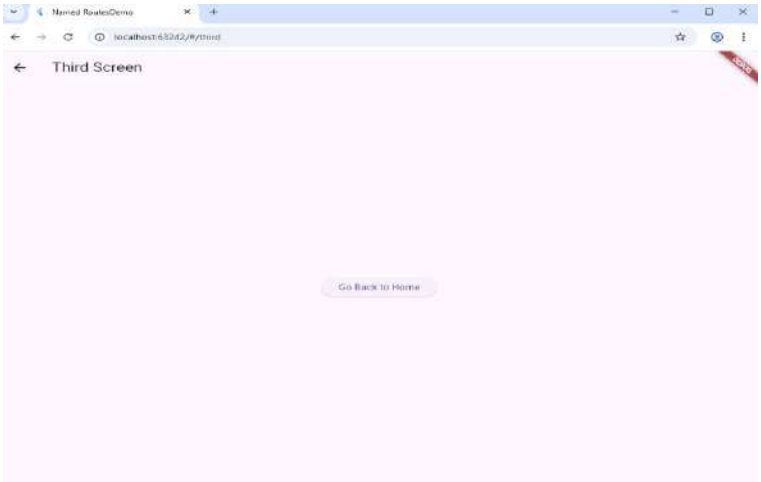
```
    );
  }
}

class SecondScreen extends StatelessWidget {
  @override
  Widget build(BuildContext context) {
    return
      Scaffold(
        appBar: AppBar(
          title: Text('Second Screen'),
        ),
        body: Center(
          child: ElevatedButton(
            onPressed: () {
              Navigator.pushNamed(context, '/third');
            },
            child: Text('Go to Third Screen'),
          ),
        ),
      );
  }
}
class ThirdScreen extends
StatelessWidget {
  @override
  Widget build(BuildContext context) {
    return Scaffold(
      appBar: AppBar(
        title: Text('Third Screen'),
      ),
      body: Center(
        child: ElevatedButton(
          onPressed: () {
            Navigator.popUntil(context, ModalRoute.withName('/'));
          },
          child: Text('Go Back to Home'),
        ),
      ),
```

```
    );
  }
}
```

OUTPUT:


Home Screen
Go to Second Screen


Second Screen
Go to Third Screen


Third Screen
Go Back to Home

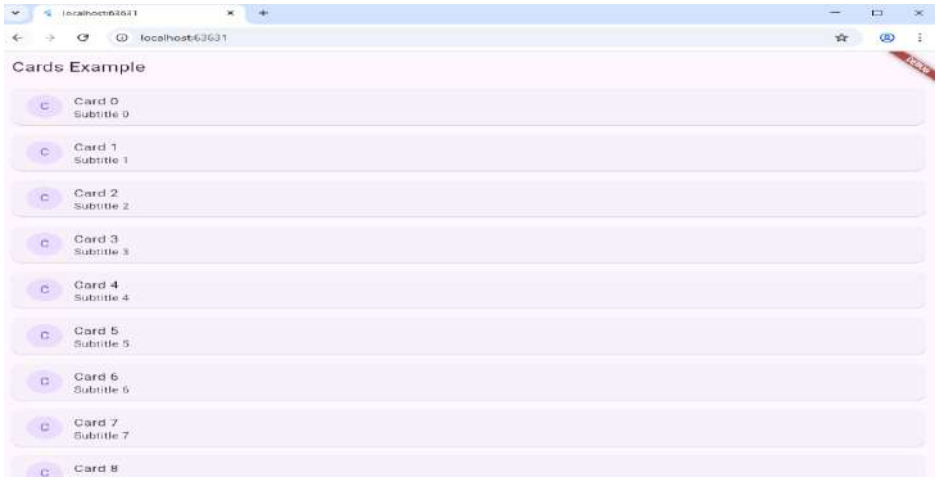
5. a) Learn about stateful and stateless widgets

PROGRAM:

```
import 'package:flutter/material.dart';

void main() {
  runApp(MyApp());
}

class MyApp extends StatelessWidget {
  @override
  Widget build(BuildContext context) {
    return MaterialApp(
      home: Scaffold(
        appBar: AppBar(
          title: Text('Cards Example'),
        ),
        body: CardList(),
      ),
    );
  }
}

class CardList extends StatelessWidget {
  @override
  Widget build(BuildContext context) {
    return ListView.builder(
      itemCount: 10,
      itemBuilder: (context, index) {
        return CardItem(
          title: 'Card $index',
          subtitle: 'Subtitle $index',
        );
      },
    );
  }
}

class CardItem extends StatelessWidget {
```

```
  final String title;
  final String subtitle;

  const CardItem({
    Key? key,
    required this.title,
    required this.subtitle,
  }) : super(key: key);

  @override
  Widget build(BuildContext context) {
    return Card(
      margin: EdgeInsets.symmetric(horizontal: 16, vertical: 8),
      child: ListTile(
        title: Text(title),
        subtitle: Text(subtitle),
        leading: CircleAvatar(
          child: Text(title.substring(0, 1)),
        ),
        onTap: () {
          // Handle card tap
        },
      ),
    );
  }
}
```

OUTPUT:



5. b) Implement state management using set state and provider

Stateful Widgets:

Definition: Stateful widgets are widgets that maintain state, allowing them to change and update over time in response to user actions, network events, or other factors.

Characteristics: They have an associated mutable state that can change during the widget's lifetime. The state is stored in a separate class that extends State and is associated with the stateful widget. Changes to the state trigger a rebuild of the widget's UI, allowing dynamic updates. They are ideal for UI elements that need to change or react to user interactions, such as input forms, animations, or scrollable lists.

PROGRAM:

```
import 'package:flutter/material.dart';

void main() {
  runApp(MyApp());
}
class MyApp extends StatelessWidget {
  @override
  Widget build(BuildContext context) {
    return MaterialApp(
      home: CounterApp(),
    );
  }
}
class CounterApp extends StatefulWidget {
  @override
  _CounterAppState createState() => _CounterAppState();
}
class _CounterAppState extends State<CounterApp> {
  int _counter = 0;
  void _incrementCounter() {
    setState(() {
      _counter++;
    });
  }
  @override
  Widget build(BuildContext context) {
    return
      Scaffold
```

```
      (
      appBar: AppBar(
        title: Text('Counter App'),
      ),
      body: Center(
        child: Column(
          mainAxisAlignment: MainAxisAlignment.center,
          children: <Widget>[
            Text(
              'Counter:',
              style: TextStyle(fontSize: 24),
            ), Text(
              '$_counter',
              style: TextStyle(fontSize: 36, fontWeight: FontWeight.bold),
            ),
          ],
        ),
      ),
      floatingActionButton: FloatingActionButton(
        onPressed:
        _incrementCounter, tooltip:
      'Increment',
        child: Icon(Icons.add),
      ),
    );
  }
}
```

OUTPUT:

Stateful widgets are composed of two classes: the stateful widget itself (which extends StatefulWidget) and its corresponding state class (which extends State). The state class is responsible for maintaining the widget's mutable state and updating the UI accordingly via the setState() method.
stateless widgets are static and immutable, while stateful widgets are dynamic and can change over time by managing their internal state. Understanding the difference between these two types of widgets is essential for designing and building efficient and responsive Flutter UIs.

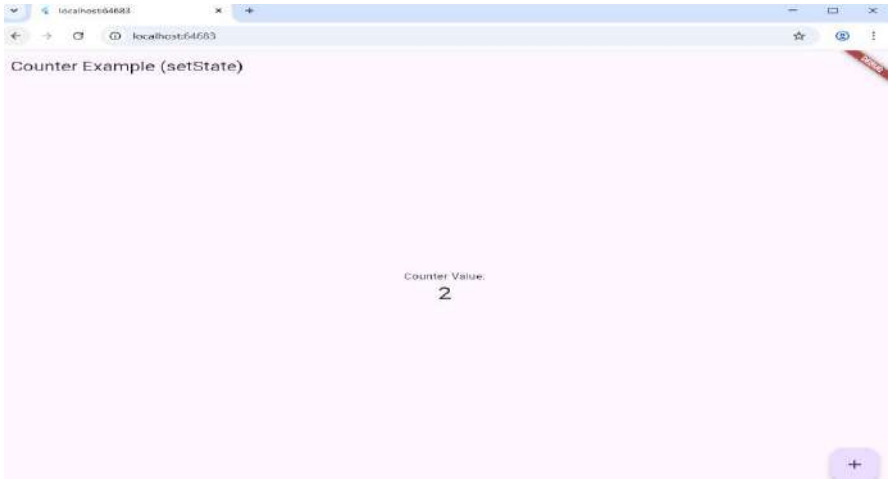
State Management using setState():

PROGRAM:

```
import 'package:flutter/material.dart';

void main() {
  runApp(MyApp());
}

class MyApp extends StatelessWidget {
  @override

 Widget build(BuildContext context) {
    return MaterialApp(
      home: CounterPage(),
    );
  }
}
class CounterPage extends StatefulWidget {
  @override
  _CounterPageState createState() => _CounterPageState();
}
class _CounterPageState extends State<CounterPage> {
  int _counter = 0;

  void _incrementCounter() {
    setState(() {
      _counter++;
    });
  }
  @override
  Widget build(BuildContext context) {
```

```
    return
      Scaffold(
        appBar: AppBar(
          title: Text('Counter Example (setState)'),
        ), body: Center(
        child: Column(
          mainAxisAlignment: MainAxisAlignment.center,
          children: <Widget>[
            Text(
              'Counter Value:',
            ), Text(
              '$_counter',
                style: Theme.of(context).textTheme.headlineMedium,
            ),
          ],
        ),
      ),
        floatingActionButton: FloatingActionButton(
          onPressed: _incrementCounter,
          tooltip: 'Increment',
          child: Icon(Icons.add),
        ),
      );
  }
}
```

OUTPUT:



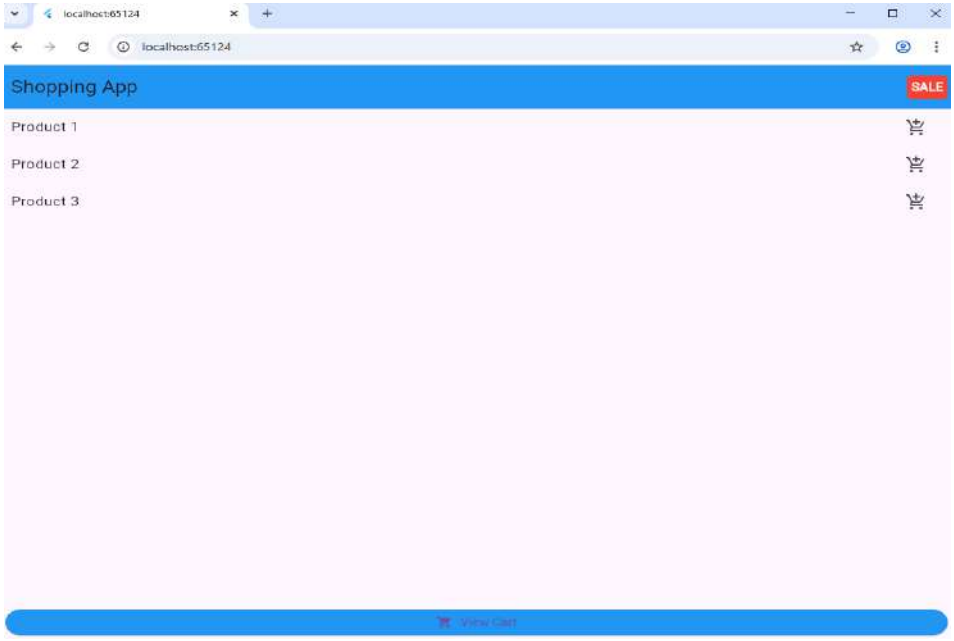
State Management using setState():

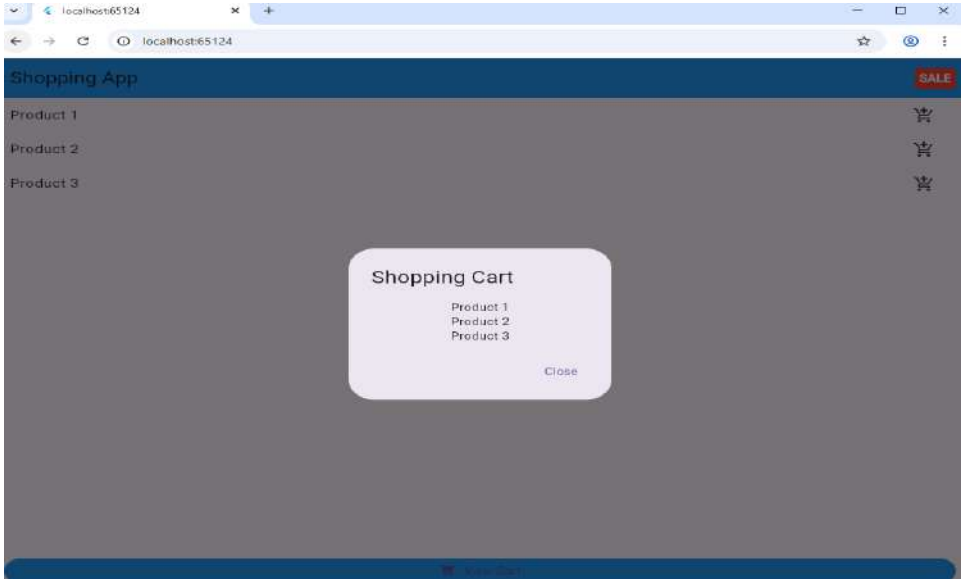
```
import 'package:flutter/material.dart';

void main() {
  runApp(ShoppingApp());
}
class ShoppingApp extends StatelessWidget {
  @override
  Widget build(BuildContext context) {
    return MaterialApp(
      debugShowCheckedModeBanner: false,
      home: ShoppingHomePage(),
    );
  }
}
class ShoppingHomePage extends StatefulWidget {
  @override
  _ShoppingHomePageState createState() => _ShoppingHomePageState();
}
class _ShoppingHomePageState extends State<ShoppingHomePage> {
  List<String> products = ["Product 1", "Product 2", "Product 3"];
  List<String> cart = [];

  void addToCart(String product) {
    setState(() {
      if (!cart.contains(product)) {
        cart.add(product);
      }
    });
  }
  void viewCart() {
    showDialog(
      context: context,
      builder: (BuildContext context) {
        return AlertDialog(
          title: Text("Shopping Cart"),
          content: Column(
            mainAxisSize: MainAxisSize.min,
            children: cart.map((item) => Text(item)).toList(),
```

```
        ),
        actions: [
          TextButton(
            child: Text("Close"),
            onPressed: () {
              Navigator.of(context).pop();
            },
          )
        ],
      );
    },
  );
}
@override
Widget build(BuildContext context) {
  return Scaffold(
    appBar: AppBar(
      title: Text("Shopping App"),
      backgroundColor: Colors.blue,
      actions: [
        Container(
          margin: EdgeInsets.only(right: 10),
          padding: EdgeInsets.all(5),
          decoration: BoxDecoration(
            color: Colors.red,
            borderRadius: BorderRadius.circular(5),
          ),
          child: Text(
            "SALE",
            style: TextStyle(color: Colors.white, fontWeight: FontWeight.bold),
          ),
        )
      ],
    ),
    body: ListView.builder(
      itemCount: products.length,
      itemBuilder: (context, index) {
        return ListTile(
          title: Text(products[index]),
```

```
          trailing: IconButton(
            icon: Icon(Icons.add_shopping_cart),
            onPressed: () => addToCart(products[index]),
          ),
        );
      },
    ),
    bottomNavigationBar: Padding(
      padding: const EdgeInsets.all(10.0),
      child: ElevatedButton.icon(
        style: ElevatedButton.styleFrom(
          backgroundColor: Colors.blue,
          padding: EdgeInsets.symmetric(vertical: 15),
          shape: RoundedRectangleBorder(
            borderRadius: BorderRadius.circular(30),
          ),
        ),
        icon: Icon(Icons.shopping_cart),
        label: Text("View Cart"),
        onPressed: viewCart,
      ),
    ),
  );
 }
}
```

OUTPUT:


localhost:65124
localhost:65124
Shopping App
SALE
Product 1
Product 2
Product 3
View Cart


localhost:65124
localhost:65124
Shopping App
SALE
Product 1
Product 2
Product 3
Shopping Cart
Product 1
Product 2
Product 3
Close

State Management using provider package:

// main.dart

```
import 'package:flutter/material.dart';
import'package:provider/provider.dart';
import 'provider/movie_provider.dart';
import 'screens/home_screen.dart';
void main() {
  runApp(ChangeNotifierProvider<MovieProvider>( child: const MyApp(),
  create: (_) => MovieProvider(), // Create a new ChangeNotifier object
  ));
}
class MyApp extends
StatelessWidget {
  const MyApp({Key? key}) : super(key: key);
  @override
  Widget build(BuildContext context) {
    return MaterialApp(
// Remove the debug banner
      debugShowCheckedModeBanner:
      false, title: 'State Management usingprovider',
      theme: ThemeData(
      primarySwatch: Colors.indigo,
    ),
    home: const HomeScreen(),
    );
    }
}
```

create a movie folder and create file movie.dart

```
class Movie {
  final String title;
  final String? runtime; // how long this movie is (in minute)
  Movie({required this.title, this.runtime});
}
```

Create a provider folder and create movie_provider.dart inside the provider folder

// provider/movie_provider.dart

```
import 'package:flutter/material.dart';
```

```
import 'dart:math';
import '../movie/movie.dart';
// A list of movies
final List<Movie> initialData = List.generate(50,
      (index) => Movie(
      title: "Movie $index",
      runtime: "${Random().nextInt(100) + 60} minutes"));
class MovieProvider with ChangeNotifier {
// All movies (that will be displayed on the Home screen)
  final List<Movie> _movies = initialData;
// Retrieve all movies
  List<Movie> get movies => _movies;
// Favorite movies (that will be shown on the MyList screen)
  final List<Movie> _myList = [];
// Retrieve favorite movies
  List<Movie> get myList => _myList;
// Adding a movie to the favorites
  void addToList(Movie movie) {
    _myList.add(movie);
    notifyListeners();
  }
// Removing a movie from the favorites
  void removeFromList(Movie movie) {
    _myList.remove(movie);
    notifyListeners();
  }
}
```

Create a screens folder for screens Create home_screen.dart for home screen page

// screens/home_screen.dart

```
import 'package:flutter/material.dart';
import 'package:provider/provider.dart';
import '../provider/movie_provider.dart';
import 'my_list_screen.dart';
class HomeScreen extends StatefulWidget {
  const HomeScreen({Key? key}) : super(key: key);
  @override
  State<HomeScreen> createState() => _HomeScreenState();
}
```

```
class _HomeScreenState extends
State<HomeScreen> {
  @override
  Widget build(BuildContext context) {
    var movies = context.watch<MovieProvider>().movies;
    var myList = context.watch<MovieProvider>().myList;
    return
      Scaffold(
          appBar: AppBar(
            title: const Text('State Management using provider'),
          ),
          body:
          Padding(
            padding: const EdgeInsets.all(15),
            child: Column(
                crossAxisAlignment: CrossAxisAlignment.stretch,
                children: [
                ElevatedButton.icon( onPressed:
                () { Navigator.of(context).push(
          MaterialPageRoute(
          builder: (context) => const MyListScreen(),
          ),
          );
          },
            icon: const Icon(Icons.favorite),
            label: Text(
              "Go to my list (${myList.length})",
              style: const TextStyle(fontSize: 24),
            ),
            style: ElevatedButton.styleFrom(
                backgroundColor: Colors.red,
                padding: const EdgeInsets.symmetric(vertical: 20)),
          ),
          const SizedBox(
            height: 15,
          ), Expanded(
          child: ListView.builder(
              itemCount: movies.length,
              itemBuilder: (_, index) {
```

```
            final currentMovie = movies[index];
            return Card(
              key: ValueKey(currentMovie.title), color:
            Colors.amberAccent.shade100, elevation: 4,
              child: ListTile(
                title: Text(currentMovie.title),
                  subtitle:
                  Text(currentMovie.runtime ?? 'No information'), trailing:
            IconButton(
              icon: Icon( Icons.favorite,
              color: myList.contains(currentMovie)
                  ? Colors.red
                  : Colors.white,
              size: 30,
              ),
              onPressed: () {
              if (!myList.contains(currentMovie)) {
                context
                    .read<MovieProvider>()
                    .addToList(currentMovie);
              } else {
                context
                    .read<MovieProvider>()
                    .removeFromList(currentMovie);
              }
              },
            ),
            ),
            );
          }),
            ),
            ],
          ),
        ),
      );
  }
}
```

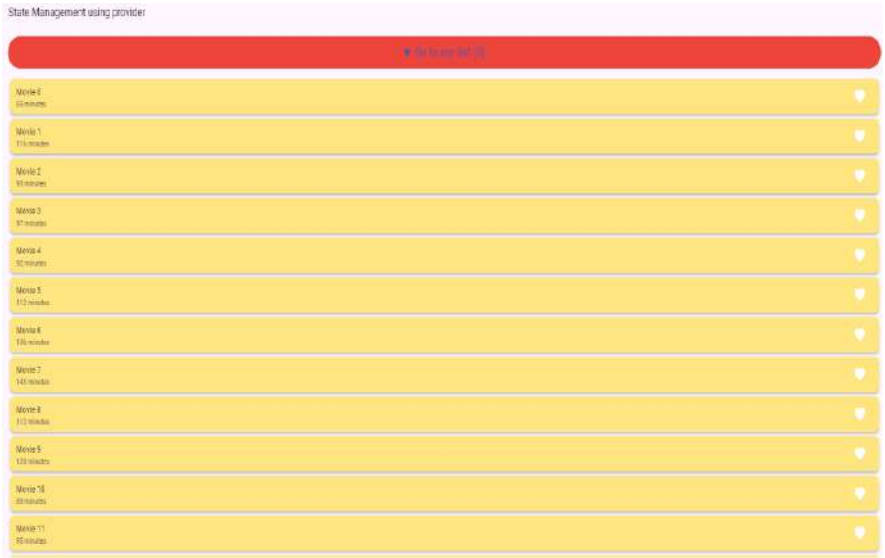
create my_list_screen.dart inside the screens folder

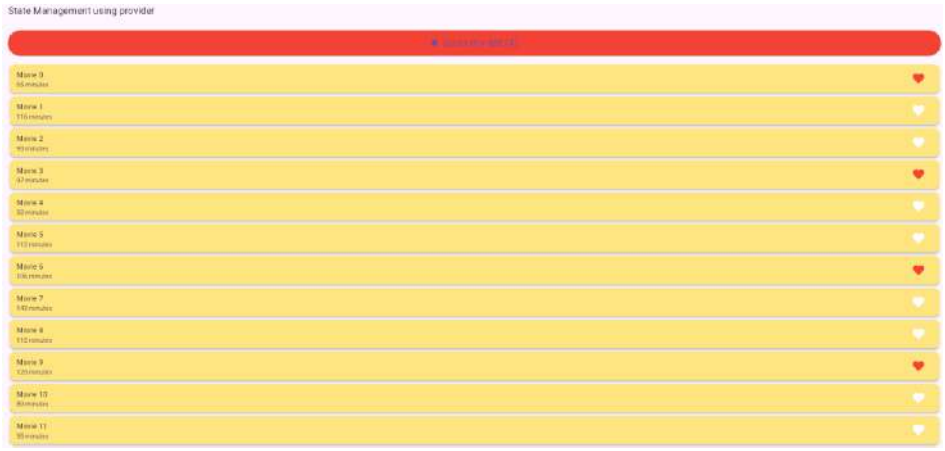
// screens/my_list_screen.dart

```
import 'package:flutter/material.dart';
import 'package:provider/provider.dart';
import '../provider/movie_provider.dart';
class MyListScreen extends StatefulWidget {
  const MyListScreen({Key? key}) : super(key:
  key);
  @override
  State<MyListScreen> createState() => _MyListScreenState();
}class _MyListScreenState extends State<MyListScreen> {
  @override
  Widget build(BuildContext context) {
    final myList = context.watch<MovieProvider>().myList;
    return Scaffold(
      appBar: AppBar(
        title: Text("My List (${myList.length})"),
      ),
      body: ListView.builder(
          itemCount: myList.length,
          itemBuilder: (_, index) {
            final currentMovie = myList[index];
            return Card(
              key: ValueKey(currentMovie.title),
              elevation: 4,
              child: ListTile(
                title: Text(currentMovie.title),
                subtitle: Text(currentMovie.runtime ?? ''),
                trailing: TextButton(
                  child: const Text(
                    'Remove',
                    style: TextStyle(color: Colors.red),
                  ),
                  onPressed: () {
                    context.read<MovieProvider>().removeFromList(currentMovie);
                  },
                ),
              ),
            );
          }),
    );
```

```
  }
}
```

OUTPUT:


State Management using provider


State Management using provider


My List (4)
Movie 0
65 minutes
Remove
Movie 3
97 minutes
Remove
Movie 6
106 minutes
Remove
Movie 9
120 minutes
Remove

6. a) Create custom widgets for specific UI elements

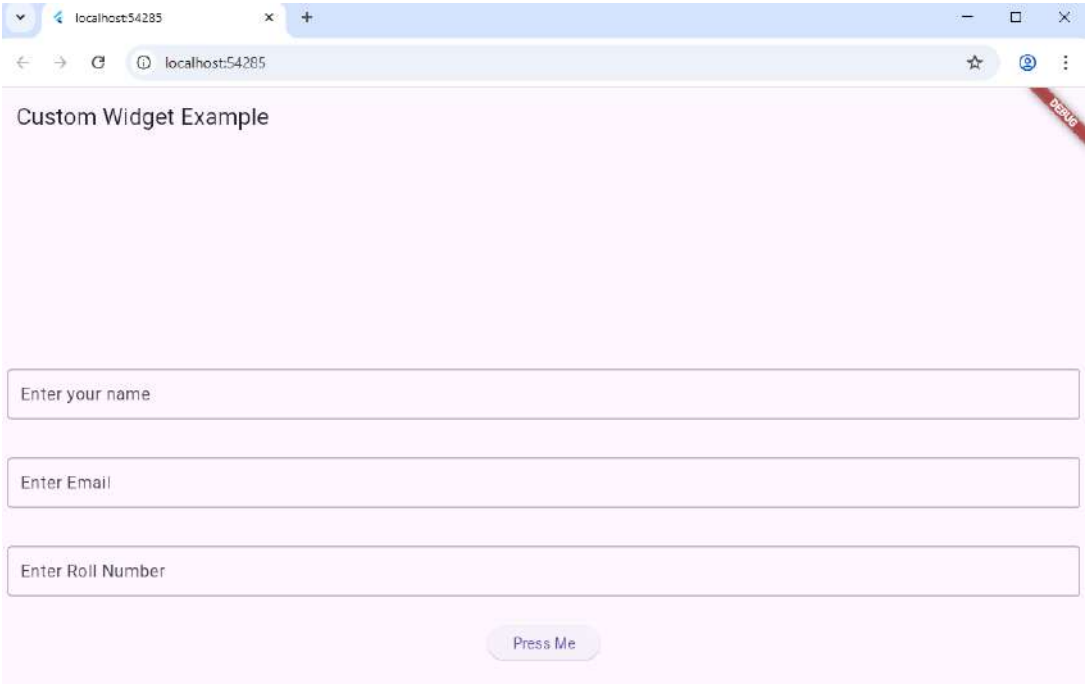
PROGRAM:

```
import 'package:flutter/material.dart';

void main() {
  runApp(MyApp());
}

class MyApp extends StatelessWidget {
  @override
  Widget build(BuildContext context) {
    return MaterialApp( home:
    Scaffold( appBar: AppBar(
      title: Text('Custom Widget Example'),
    ),
      body: Column(
          mainAxisAlignment: MainAxisAlignment.center, children:
          <Widget>[
          Padding(
          padding: const EdgeInsets.all(8.0), child:
      CustomTextField(
        hintText: 'Enter your name', onChanged: (value) {
        print('Name changed: $value');
      },
      ),
    ),
      SizedBox(height: 20), Padding(
        padding: const EdgeInsets.all(8.0), child:
      CustomTextField(
        hintText: 'Enter Email', onChanged: (value) {
        print('Name changed: $value');
      },
      ),
      ),
      SizedBox(height: 20), Padding(
        padding: const EdgeInsets.all(8.0), child:
      CustomTextField(
```

```
      hintText: 'Enter Roll Number', onChanged: (value)
     { print('Name changed: $value');
     },
     ),
     ),
          SizedBox(height: 20), CustomButton(
          text: 'Press Me',
          onPressed: () {
            print('Button pressed!');
          },
        ),
        ],
     ),
   ),
   );
  }
}
class CustomButton extends StatelessWidget {
  final String? text;
  final VoidCallback? onPressed;
  const CustomButton({ Key?
  key,
    @required this.text,
    @required this.onPressed,
  }) : super(key: key);
  @override
  Widget build(BuildContext context) {
    return ElevatedButton( onPressed:
    onPressed, child: Text(text!),
    );
  }
}
class CustomTextField extends StatelessWidget {
  final String hintText;
  final ValueChanged<String> onChanged;
  const CustomTextField({ Key?
  key,
    required this.hintText, required
```

```
    this.onChanged,
  }) : super(key: key);
  @override
  Widget build(BuildContext context) {
    return TextField( onChanged:
    onChanged, decoration: InputDecoration(
      hintText: hintText,
      border: OutlineInputBorder(),
    ),
    );
  }
}
```

OUTPUT:



6. b) Apply styling using themes and custom styles

In Flutter, you can apply styling to your widgets using themes and custom styles to maintain consistency and make your UI more visually appealing.

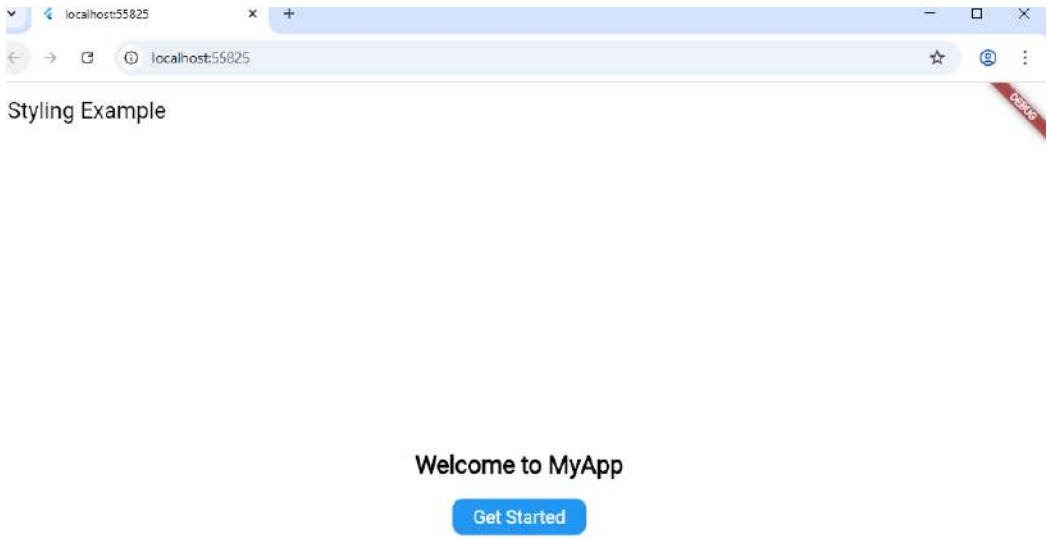
PROGRAM:

```
import 'package:flutter/material.dart';
void main() {
  runApp(MyApp());
}
class MyApp extends StatelessWidget {
  @override
  Widget build(BuildContext context) {
    return MaterialApp(
      theme: ThemeData(
        primaryColor: Colors.blue,
        colorScheme: ColorScheme.fromSwatch().copyWith(secondary: Colors.orange),
        fontFamily: 'Roboto',
        textTheme: TextTheme(
          displayLarge: TextStyle(fontSize: 24, fontWeight: FontWeight.bold), // for headings
          bodyLarge: TextStyle(fontSize: 16), // for body text
        ),

        elevatedButtonTheme: ElevatedButtonThemeData(
          style: ElevatedButton.styleFrom(
            backgroundColor: Colors.blue,
            foregroundColor: Colors.white,
            textStyle: TextStyle(fontSize: 18),
            padding: EdgeInsets.symmetric(horizontal: 20, vertical: 15),
            shape: RoundedRectangleBorder(
              borderRadius: BorderRadius.circular(10),
            ),
          ),
        ),
      ),
      home: HomePage(),
    );
  }
}
```

```
class HomePage extends StatelessWidget {
  @override
  Widget build(BuildContext context) {
    return
      Scaffold(
        appBar: AppBar(
          title: Text('Styling Example'),
        ),
        body: Center(
          child: Column(
            mainAxisAlignment:
            MainAxisAlignment.center, children:
          <Widget>[
            Text(
              'Welcome to MyApp',
              style: Theme.of(context).textTheme.displayLarge,
            ),

            SizedBox(
                height:
                20),
          ElevatedButton(
            onPressed: () {
              // Action here
            },
            style: ElevatedButton.styleFrom(
              backgroundColor: Colors.blue,
              foregroundColor: Colors.white,
              padding: EdgeInsets.symmetric(horizontal: 20, vertical: 15),
              textStyle: TextStyle(fontSize: 18),
              shape: RoundedRectangleBorder(
                borderRadius: BorderRadius.circular(10),
              ),
            ),
            child: Text('Get Started'),
          ),
          ],
          ),
```

```
        ),
      );
  }
}
```

OUTPUT:


localhost:55825
localhost:55825
Styling Example
DEBUG
Welcome to MyApp
Get Started

7. a) Design a form with various input fields.

Form with various input fields such as text fields, checkboxes, radio buttons, and a dropdown menu.

PROGRAM:

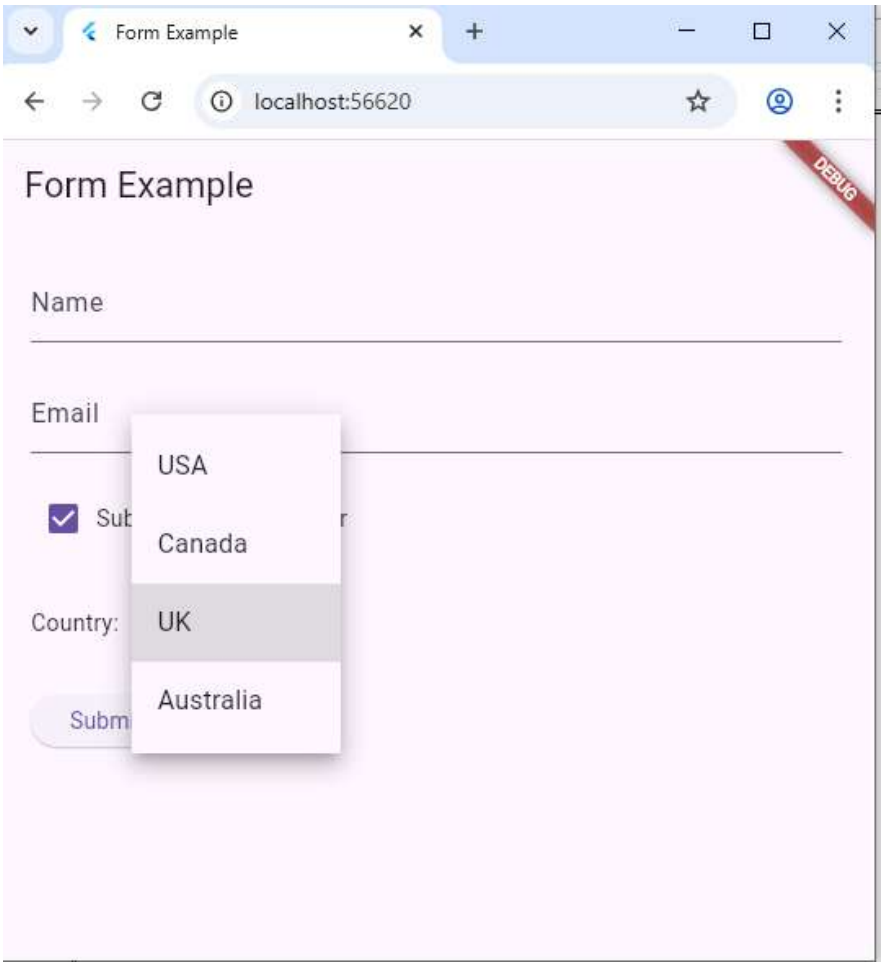
```
import 'package:flutter/material.dart';

void main() {
  runApp(MyApp());
}

class MyApp extends StatelessWidget {
  @override
  Widget build(BuildContext context) {
    return MaterialApp(
      title: 'Form Example',
      theme: ThemeData(
        primarySwatch: Colors.blue,
      ),
      home: FormPage(),
    );
  }
}

class FormPage extends StatefulWidget {
  @override
  _FormPageState createState() => _FormPageState();
}

class _FormPageState extends State<FormPage> {
  final _formKey = GlobalKey<FormState>();
  String? _name;
  String? _email;
  bool _subscribeToNewsletter = false;
  String _selectedCountry = 'USA';

  @override

  Widget build(BuildContext context) {
```

```
    return Scaffold(
      appBar: AppBar(
        title: Text('Form Example'),
      ),
      body: Padding(
        padding: EdgeInsets.all(20.0),
        child: SingleChildScrollView(
          child: Form(
            key: _formKey,
            child: Column(
              crossAxisAlignment: CrossAxisAlignment.start,
              children: <Widget>[
                // Name TextFormField
                TextFormField(
                  decoration: InputDecoration(labelText: 'Name'),
                  onSaved: (value) {
                    _name = value ?? '';
                  },
                ),
                SizedBox(height: 20),

                // Email TextFormField
                TextFormField(
                  decoration: InputDecoration(labelText: 'Email'),
                  onSaved: (value) {
                    _email = value ?? '';
                  },
                ),
                SizedBox(height: 20),

                // Subscribe Checkbox
                Row(
                  children: <Widget>[
                    Checkbox(
                      value: _subscribeToNewsletter,
                      onChanged: (bool? value) {
                        setState(() {
                          _subscribeToNewsletter = value ?? false;
                        });
```

```
        },
      ),
      Text('Subscribe to Newsletter'),
    ],
  ),
  SizedBox(height: 20),

  // Country Dropdown
  Row(
    children: <Widget>[
      Text('Country: '),
      SizedBox(width: 20),
      DropdownButton<String>(
        value: _selectedCountry,
        onChanged: (String? value) {
          setState(() {
            _selectedCountry = value ?? 'USA';
          });
        },
        items: <String>['USA', 'Canada', 'UK', 'Australia']
            .map<DropdownMenuItem<String>>((String value) {
          return DropdownMenuItem<String>(
            value: value,
            child: Text(value),
          );
        }).toList(),
      ),
    ],
  ),
  SizedBox(height: 20),

  // Submit Button
  ElevatedButton(
    onPressed: () {
      _formKey.currentState!.save(); // Save form data
      print('Name: $_name');
      print('Email: $_email');
      print('Subscribe to Newsletter: $_subscribeToNewsletter');
      print('Country: $_selectedCountry');
```

```
                },
                child: Text('Submit'),
              ),
            ],
          ),
        ),
      ),
    ),
  );
 }
}
```

OUTPUT:



7 b) Implement form validation and error handling.

PROGRAM:

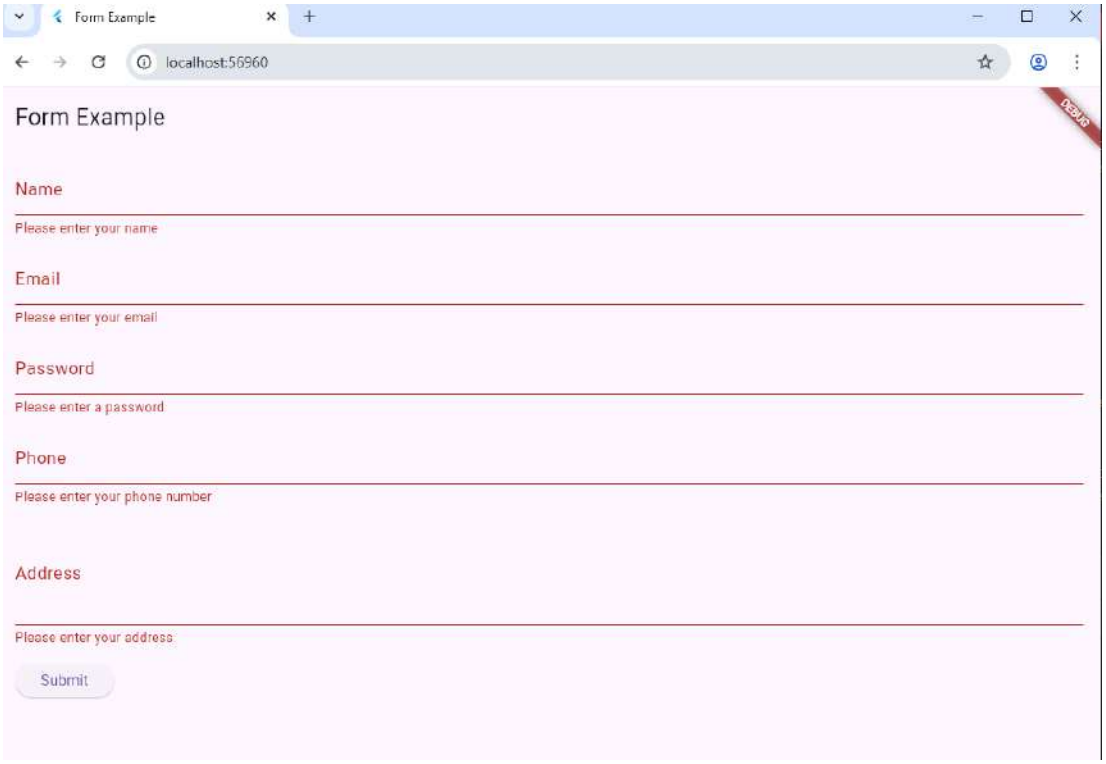
```
import 'package:flutter/material.dart';

void main() {
  runApp(MyApp());
}

class MyApp extends StatelessWidget {
  @override
  Widget build(BuildContext context) {
    return MaterialApp(
      title: 'Form Example',
      home: Scaffold(
        appBar: AppBar(
          title: Text('Form Example'),
        ),
        body: SingleChildScrollView(
          padding: EdgeInsets.all(16),
          child: FormWidget(),
        ),
      ),
    );
  }
}

class FormWidget extends StatefulWidget {
  @override
  _FormWidgetState createState() => _FormWidgetState();
}

class _FormWidgetState extends State<FormWidget> {
  final _formKey = GlobalKey<FormState>();

  String? _name;
  String? _email;
  String? _password;
  String? _phone;
```

```
String? _address;
 @override
 Widget build(BuildContext context) {
  return Form(
    key: _formKey,
    child: Column(
      crossAxisAlignment: CrossAxisAlignment.start,
      children: <Widget>[
        // Name field
        TextFormField(
          decoration: InputDecoration(labelText: 'Name'),
          validator: (value) {
            if (value == null || value.isEmpty) {
              return 'Please enter your name';
            }
            return null;
          },
          onSaved: (value) => _name = value,
        ),
        SizedBox(height: 16),

        // Email field
        TextFormField(
          decoration: InputDecoration(labelText: 'Email'),
          keyboardType: TextInputType.emailAddress,
          validator: (value) {
            if (value == null || value.isEmpty) {
              return 'Please enter your email';
            }
            if (!RegExp(r'\S+@\S+\.\S+').hasMatch(value)) {
              return 'Please enter a valid email';
            }
            return null;
          },
          onSaved: (value) => _email = value,
        ),
        SizedBox(height: 16),
```

```
// Password field
  TextFormField(
    decoration: InputDecoration(labelText: 'Password'),
    obscureText: true,
    validator: (value) {
      if (value == null || value.isEmpty) {
        return 'Please enter a password';
      }
      if (value.length < 6) {
        return 'Password must be at least 6 characters';
      }
      return null;
    },
    onSaved: (value) => _password = value,
  ),
  SizedBox(height: 16),

  // Phone field
  TextFormField(
    decoration: InputDecoration(labelText: 'Phone'),
    keyboardType: TextInputType.phone,
    validator: (value) {
      if (value == null || value.isEmpty) {
        return 'Please enter your phone number';
      }
      return null;
    },
    onSaved: (value) => _phone = value,
  ),
  SizedBox(height: 16),

  // Address field
  TextFormField(
    decoration: InputDecoration(labelText: 'Address'),
    maxLines: 3,
    validator: (value) {
      if (value == null || value.isEmpty) {
        return 'Please enter your address';
```

```
            }
            return null;
          },
          onSaved: (value) => _address = value,
        ),
        SizedBox(height: 16),

        // Submit button
        ElevatedButton(
          onPressed: _submitForm,
          child: Text('Submit'),
        ),
      ],
    ),
  );
}

void _submitForm() {
  if (_formKey.currentState!.validate()) {
    _formKey.currentState!.save();

    // Print form data
    print('Form submitted:');
    print('Name: $_name');
    print('Email: $_email');
    print('Password: $_password');
    print('Phone: $_phone');
    print('Address: $_address');

    // Optional: Show confirmation on screen
    ScaffoldMessenger.of(context).showSnackBar(
      SnackBar(content: Text('Form submitted successfully!')),
    );
  }
}
}
```

OUTPUT:


Form Example
localhost:56960
Form Example
DEBUG
Name
Please enter your name
Email
Please enter your email
Password
Please enter a password
Phone
Please enter your phone number
Address
Please enter your address
Submit

8. a) Add animations to UI elements using flutter's animation framework.

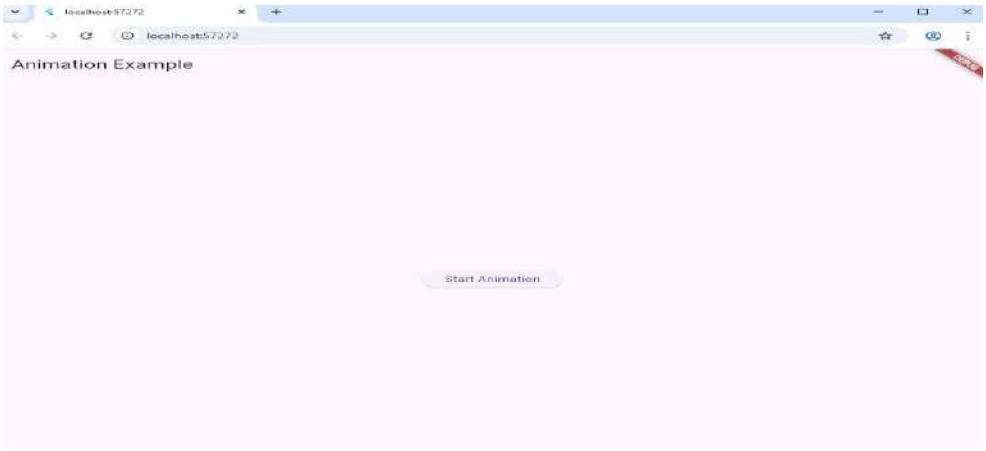
PROGRAM:

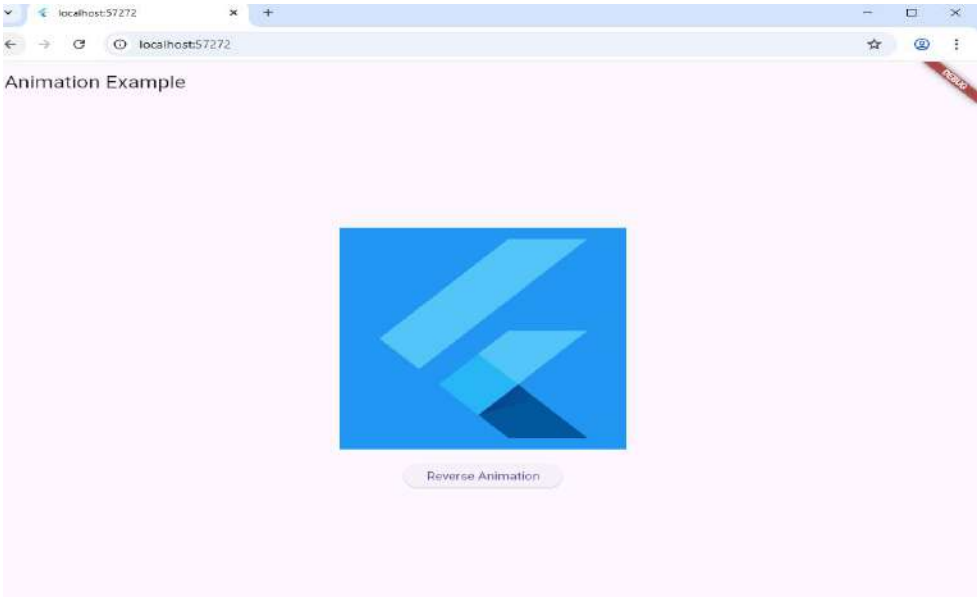
```
import 'package:flutter/material.dart';

void main() {
  runApp(MyApp());
}

class MyApp extends StatelessWidget {
  @override
  Widget build(BuildContext context) {
    return MaterialApp(
      home: Scaffold(
        appBar: AppBar(
          title: Text('Animation Example'),
        ),
        body: AnimationWidget(),
      ),
    );
  }
}

class AnimationWidget extends StatefulWidget {
  @override
  _AnimationWidgetState createState() => _AnimationWidgetState();
}

class _AnimationWidgetState extends State<AnimationWidget>
    with SingleTickerProviderStateMixin {
  late AnimationController _controller;
  late Animation<double> _animation;

  @override
  void initState() {
    super.initState();
    _controller = AnimationController(
      duration: Duration(seconds: 1),
```

```
    vsync: this,
  );

  _animation = Tween<double>(begin: 0, end: 300).animate(_controller)
    ..addListener(() {
      setState(() {}); // Trigger rebuild when animation value changes
    });
}

@override
Widget build(BuildContext context) {
  return Center(
    child: Column(
      mainAxisAlignment: MainAxisAlignment.center,
      children: <Widget>[
        Container(
          width: _animation.value,
          height: _animation.value,
          color: Colors.blue,
          child: FlutterLogo(size: 100),
        ),
        SizedBox(height: 20),
        ElevatedButton(
          onPressed: () {
            if (_controller.status == AnimationStatus.completed) {
              _controller.reverse();
            } else {
              _controller.forward();
            }
          },
          child: Text(
            _controller.status == AnimationStatus.completed
                ? 'Reverse Animation'
                : 'Start Animation',
          ),
        ),
      ],
    ),
  );
```

```
  }

  @override
  void dispose() {
    _controller.dispose();
    super.dispose();
  }
}
```

OUTPUT:





8. b) Experiment with different types of animations like fade,slide,etc.

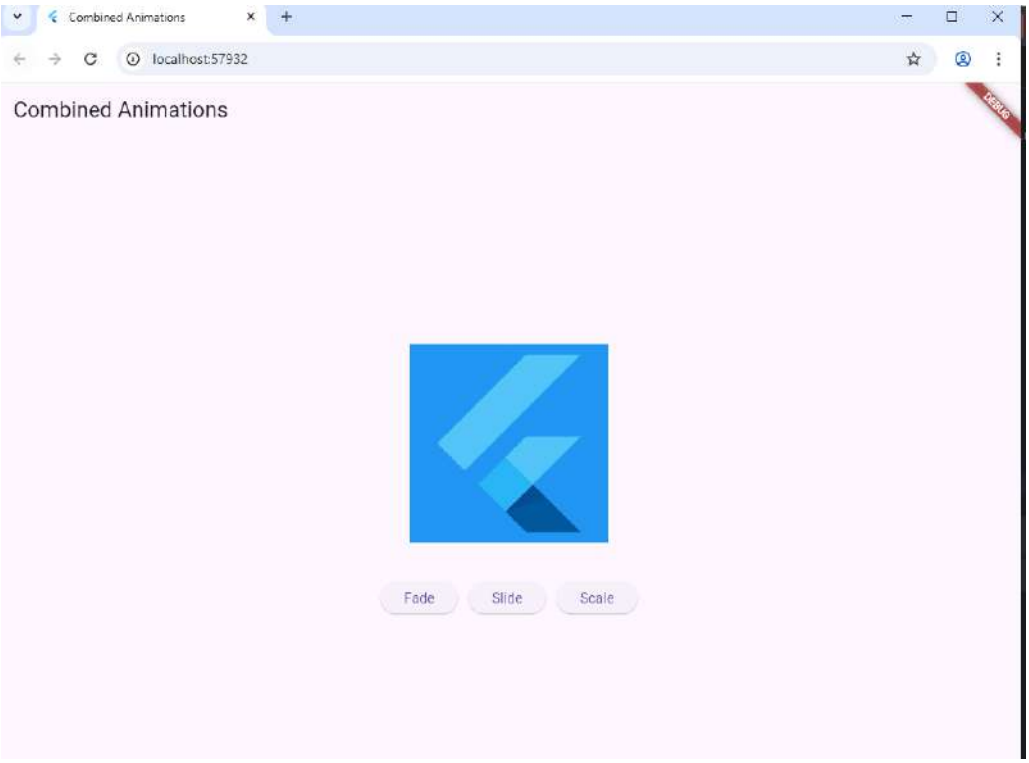
PROGRAM:

```
import 'package:flutter/material.dart';

void main() {
  runApp(MyApp());
}

enum AnimationType { fade, slide, scale }

class MyApp extends StatelessWidget {
  @override
  Widget build(BuildContext context) {
    return MaterialApp(
      title: 'Combined Animations',
      home: AnimationHome(),
    );
  }
}

class AnimationHome extends StatefulWidget {
  @override
  _AnimationHomeState createState() => _AnimationHomeState();
}

class _AnimationHomeState extends State<AnimationHome>
    with SingleTickerProviderStateMixin {
  late AnimationController _controller;
  late Animation<double> _fadeAnimation;
  late Animation<Offset> _slideAnimation;
  late Animation<double> _scaleAnimation;

  AnimationType _currentAnimation = AnimationType.fade;

  @override
  void initState() {
    super.initState();
```

```
  _controller = AnimationController(
    duration: Duration(seconds: 2),
    vsync: this,
  );

  _fadeAnimation = Tween<double>(begin: 0.0, end: 1.0).animate(_controller);
  _slideAnimation =
      Tween<Offset>(begin: Offset(-1, 0), end: Offset(0, 0)).animate(_controller);
  _scaleAnimation = Tween<double>(begin: 0.0, end: 1.0).animate(_controller);

  _controller.forward();
}

void _changeAnimation(AnimationType type) {
  setState(() {
    _currentAnimation = type;
    _controller.reset();
    _controller.forward();
  });
}

Widget _buildAnimatedWidget() {
  final container = Container(
    width: 200,
    height: 200,
    color: Colors.blue,
    child: FlutterLogo(size: 100),
  );

  switch (_currentAnimation) {
    case AnimationType.fade:
      return FadeTransition(opacity: _fadeAnimation, child: container);
    case AnimationType.slide:
      return SlideTransition(position: _slideAnimation, child: container);
    case AnimationType.scale:
      return ScaleTransition(scale: _scaleAnimation, child: container);
    default:
      return container;
```

```
    }
  }

  @override
  Widget build(BuildContext context) {
    return Scaffold(
      appBar: AppBar(title: Text('Combined Animations')),
      body: Column(
        mainAxisAlignment: MainAxisAlignment.center,
        children: [
          Center(child: _buildAnimatedWidget()),
          SizedBox(height: 40),
          Wrap(
            spacing: 10,
            children: [
              ElevatedButton(
                onPressed: () => _changeAnimation(AnimationType.fade),
                child: Text('Fade'),
              ),
              ElevatedButton(
                onPressed: () => _changeAnimation(AnimationType.slide),
                child: Text('Slide'),
              ),
              ElevatedButton(
                onPressed: () => _changeAnimation(AnimationType.scale),
                child: Text('Scale'),
              ),
            ],
          ),
        ],
      ),
    );
  }
  @override
  void dispose() {
    _controller.dispose();
    super.dispose();
  }
}
```

OUTPUT:


Combined Animations
localhost:57932
Combined Animations
DEBUG
Fade
Slide
Scale

9. a) Fetch data from REST API

dependancy in pubspec.yaml:

```
dependencies:
  flutter:
    sdk: flutter
  http: ^1.1.0
```

In your terminal, run:

flutter pub get

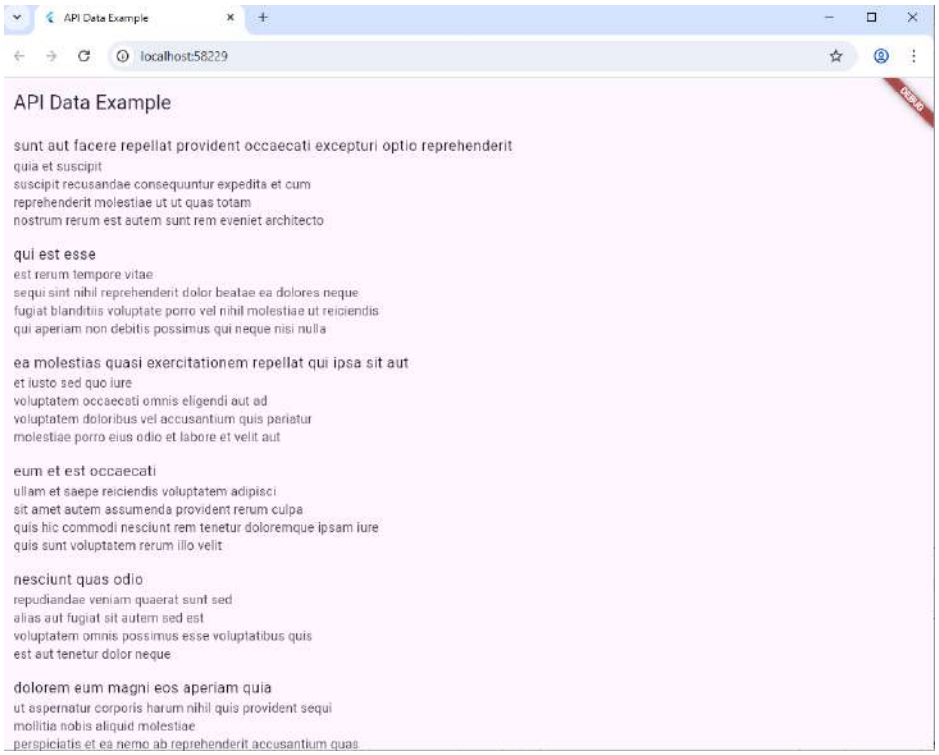
PROGRAM:

```
import 'dart:convert';
import 'package:flutter/material.dart';
import 'package:http/http.dart' as http;

void main() {
  runApp(MyApp());
}

class MyApp extends StatelessWidget {
  @override
  Widget build(BuildContext context) {
    return MaterialApp(
      title: 'API Data Example',
      home: HomePage(),
    );
  }
}

class HomePage extends StatefulWidget {
  @override
  _HomePageState createState() => _HomePageState();
}

class _HomePageState extends State<HomePage> {
  List<dynamic> _data = [];
  bool _isLoading = true;
```

```
  String? _error;

  @override
  void initState() {
    super.initState();
    _fetchDataFromApi();
  }

  Future<void> _fetchDataFromApi() async {
    try {
      final response = await http
          .get(Uri.parse('https://jsonplaceholder.typicode.com/posts'));

      if (response.statusCode == 200) {
        setState(() {
          _data = json.decode(response.body);
          _isLoading = false;
        });
      } else {
        setState(() {
          _error = 'Failed to load data';
          _isLoading = false;
        });
      }
    } catch (e) {
      setState(() {
        _error = e.toString();
        _isLoading = false;
      });
    }
  }

  @override
  Widget build(BuildContext context) {
    return Scaffold(
      appBar: AppBar(
        title: Text('API Data Example'),
      ),
```

```
      body: _isLoading
        ? Center(child: CircularProgressIndicator())
        : _error != null
        ? Center(child: Text('Error: $_error'))
        : ListView.builder(
      itemCount: _data.length,
      itemBuilder: (context, index) {
        return ListTile(
          title: Text(_data[index]['title'] ?? ''),
          subtitle: Text(_data[index]['body'] ?? ''),
        );
      },
    ),
  );
 }
}
```

OUTPUT:



9. b) Display the fetched data in a meaningful way in the UI.

Display the fetched data in a meaningful way in the UI, we can use a more structured layout rather than just displaying the data in a list. We'll create a custom widget to represent each post fetched from the API, and display them in a scrollable list.

PROGRAM:

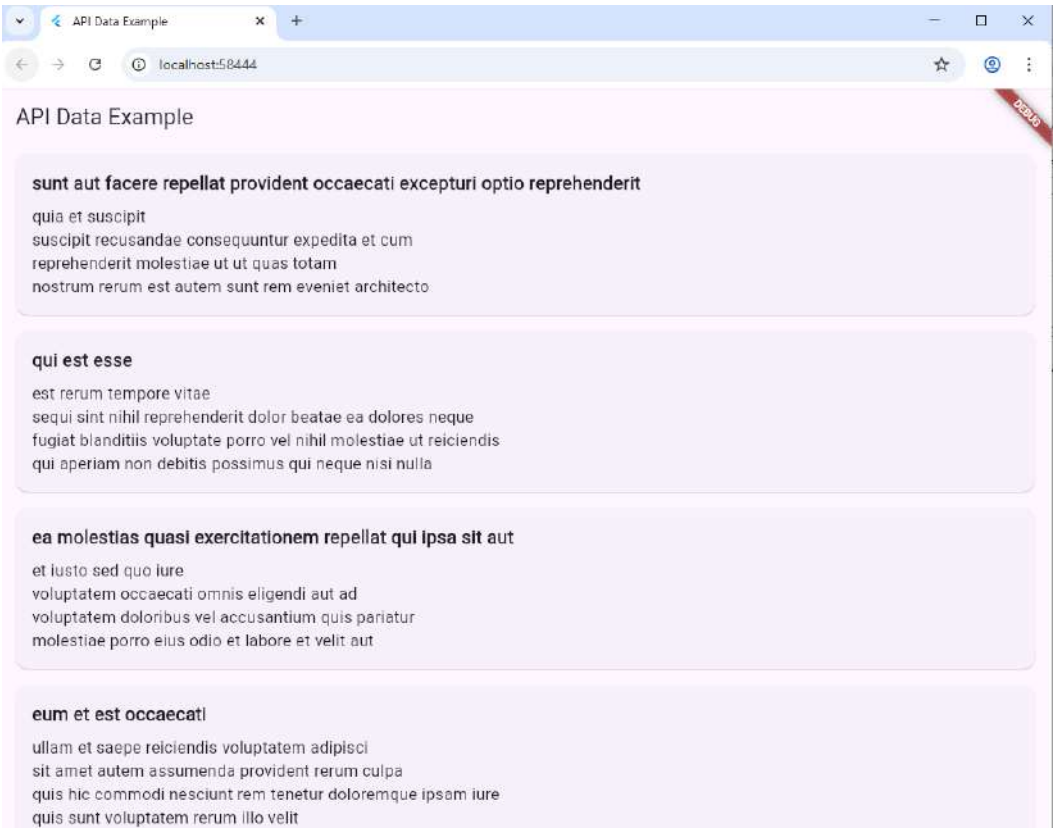
```
import 'dart:convert';
import 'package:flutter/material.dart';
import 'package:http/http.dart' as http;

void main() {
  runApp(MyApp());
}

class MyApp extends StatelessWidget {
  @override
  Widget build(BuildContext context) {
    return MaterialApp(
      title: 'API Data Example',
      home: HomePage(),
    );
  }
}

class HomePage extends StatefulWidget {
  @override
  _HomePageState createState() => _HomePageState();
}

class _HomePageState extends State<HomePage> {
  List<dynamic> _data = [];
  bool _isLoading = false;

  @override
  void initState() {
    super.initState();
    _fetchDataFromApi();
  }
```

```
Future<void> _fetchDataFromApi() async {
  setState(() {
    _isLoading = true;
  });

  try {
    final response = await http
        .get(Uri.parse('https://jsonplaceholder.typicode.com/posts'));

    if (response.statusCode == 200) {
      setState(() {
        _data = json.decode(response.body);
        _isLoading = false;
      });
    } else {
      throw Exception('Failed to load data');
    }
  } catch (e) {
    setState(() {
      _isLoading = false;
    });
    print('Error: $e');
  }
}

@override
Widget build(BuildContext context) {
  return Scaffold(
    appBar: AppBar(
      title: Text('API Data Example'),
    ),
    body: _isLoading
        ? Center(child: CircularProgressIndicator())
        : ListView.builder(
      itemCount: _data.length,
      itemBuilder: (context, index) {
        return PostCard(
          title: _data[index]['title'] ?? '',
```

```
            body: _data[index]['body'] ?? '',
          );
        },
      ),
    );
  }
}

class PostCard extends StatelessWidget {
  final String title;
  final String body;

  const PostCard({
    Key? key,
    required this.title,
    required this.body,
  }) : super(key: key);

  @override
  Widget build(BuildContext context) {
    return Card(
      margin: EdgeInsets.symmetric(horizontal: 16, vertical: 8),
      child: Padding(
        padding: EdgeInsets.all(16),
        child: Column(
          crossAxisAlignment: CrossAxisAlignment.start,
          children: [
            Text(
              title,
              style: TextStyle(fontSize: 18, fontWeight: FontWeight.bold),
            ),
            SizedBox(height: 8),
            Text(
              body,
              style: TextStyle(fontSize: 16),
            ),
          ],
        ),
      ),
```

```
    );
  }
}
```

OUTPUT:



We've added a loading indicator (CircularProgressIndicator) to indicate when data is being fetched. The fetched data is displayed as a list of PostCard widgets, each representing a post from the API. The PostCard widget displays the title and body of each post in a structured manner using a Card layout

10 a) Write unit tests for UI components

Program:

```
import 'package:flutter/material.dart';
import 'package:flutter_test/flutter_test.dart';
import 'package:untitled9/post_card.dart'; // Import your widget file

void main() {
  testWidgets('PostCard displays title and body', (WidgetTester tester) async {
// Build our widget and trigger aframe.
    await tester.pumpWidget(
    MaterialApp( home:
    PostCard( title: 'Test Title',
    body: 'Test Body',
    ),
    ),
    );

// Verify that the title and body are displayed correctly.
    expect(find.text('Test Title'),
    findsOneWidget); expect(find.text('Test Body'),
    findsOneWidget);
  });

  testWidgets('PostCard widget has correct styling', (WidgetTester tester) async {
// Build our widget and trigger a frame.
    await tester.pumpWidget(
    MaterialApp( home:
    PostCard( title: 'Test Title',
        body: 'Test Body',
    ),
    ),
    );

// Verify that the text styles are applied correctly.
    final titleText = tester.widget<Text>(find.text('Test Title'));
    expect(titleText.style?.fontSize, 18);
    expect(titleText.style?.fontWeight, FontWeight.bold);

    final bodyText = tester.widget<Text>(find.text('Test Body'));
```

```
    expect(bodyText.style?.fontSize, 16);
  });
}
```

OUTPUT:

```
═══╡ EXCEPTION CAUGHT BY FLUTTER TEST FRAMEWORK ╞═══════════════════════════
The following assertion was thrown running a test:
A SemanticsHandle was active at the end of the test.
All SemanticsHandle instances must be disposed by calling dispose() on the SemanticsHandle.

When the exception was thrown, this was the stack:
dart-sdk/lib/_internal/js_dev_runtime/private/ddc_runtime/errors.dart 266:3      throw_
package:flutter_test/src/widget_tester.dart 1076:7                              [_verifySemanticsHandlesWereDisposed]
package:flutter_test/src/widget_tester.dart 1065:5                              [_endOfTestVerifications]
dart-sdk/lib/_internal/js_dev_runtime/private/ddc_runtime/operations.dart 117:77 tear
package:flutter_test/src/binding.dart 1078:22                                   <fn>
dart-sdk/lib/_internal/js_dev_runtime/patch/async_patch.dart 622:19              <fn>
dart-sdk/lib/_internal/js_dev_runtime/patch/async_patch.dart 647:23              <fn>
dart-sdk/lib/_internal/js_dev_runtime/patch/async_patch.dart 593:31              <fn>
dart-sdk/lib/async/zone.dart 1538:47                                             _rootRunUnary
dart-sdk/lib/_internal/js_dev_runtime/private/ddc_runtime/operations.dart 117:77 tear
dart-sdk/lib/async/zone.dart 1429:19                                             runUnary
dart-sdk/lib/async/future_impl.dart 224:18                                       handleValue
dart-sdk/lib/async/future_impl.dart 951:44                                       handleValueCallback
dart-sdk/lib/async/future_impl.dart 980:13                                       _propagateToListeners
dart-sdk/lib/async/future_impl.dart 723:5                                        [_completeWithValue]
dart-sdk/lib/async/future_impl.dart 807:7                                        <fn>
dart-sdk/lib/async/zone.dart 1525:13                                             _rootRun
dart-sdk/lib/_internal/js_dev_runtime/private/ddc_runtime/operations.dart 117:77 tear
dart-sdk/lib/async/zone.dart 1422:19                                             run
dart-sdk/lib/async/zone.dart 1321:7                                              runGuarded
package:fake_async/fake_async.dart 189:17                                        <fn>
package:fake_async/fake_async.dart 200:19                                        flushMicrotasks
package:flutter_test/src/binding.dart 1590:16                                    <fn>
```

```
The test description was:
  PostCard widget has correct styling
═══════════════════════════════════════════════════════════════════════════
00:00 +0 -1: PostCard widget has correct styling [E]
  Test failed. See exception logs above.
  The test description was: PostCard widget has correct styling

00:00 +0 -2: Some tests failed.
```

10 b) Use flutter's debugging tools to identify and fix issues?

demonstrate the use of Flutter's debugging tools, let's consider a scenario where we have a simple counter app, but there's a bug where the counter is not incrementing when the "+" button is pressed. We'll use Flutter's debugging tools to identify and fix this issue. Here's the code for the counter app:

PROGRAM:

```
import 'package:flutter/material.dart';
void main() {
  runApp(MyApp());
}
class MyApp extends StatelessWidget {
  @override
  Widget build(BuildContext context) {
    return MaterialApp(
      home: CounterApp(),
    );
  }
}
class CounterApp extends StatefulWidget {
  @override
  _CounterAppState createState() => _CounterAppState();
}
class _CounterAppState extends State<CounterApp> {
  int _counter = 0;
  void _incrementCounter() {
    setState(() {
      _counter++;
    });
  }
  @override
  Widget build(BuildContext context) {
    return Scaffold(
      appBar: AppBar(
        title: Text('Counter App'),
      ),
      body: Center(
        child: Column(
```

```
        mainAxisAlignment: MainAxisAlignment.center,
        children: <Widget>[
          Text(
            'Counter:',
            style: TextStyle(fontSize: 24),
          ),
          Text(
            '$_counter',
            style: TextStyle(fontSize: 36, fontWeight: FontWeight.bold),
          ),
        ],
      ),
    ),
    floatingActionButton: FloatingActionButton(
      onPressed: _incrementCounter,
      tooltip: 'Increment',
      child: Icon(Icons.add),
    ),
  );
 }
}
```

OUTPUT: