

**CCIS**

كلية علوم الحاسوب والمعلومات  
COLLEGE OF COMPUTER &  
INFORMATION SCIENCES



جامعة الأمير سلطان  
**PRINCE SULTAN**  
UNIVERSITY



# IS487 Emerging Topics in IS

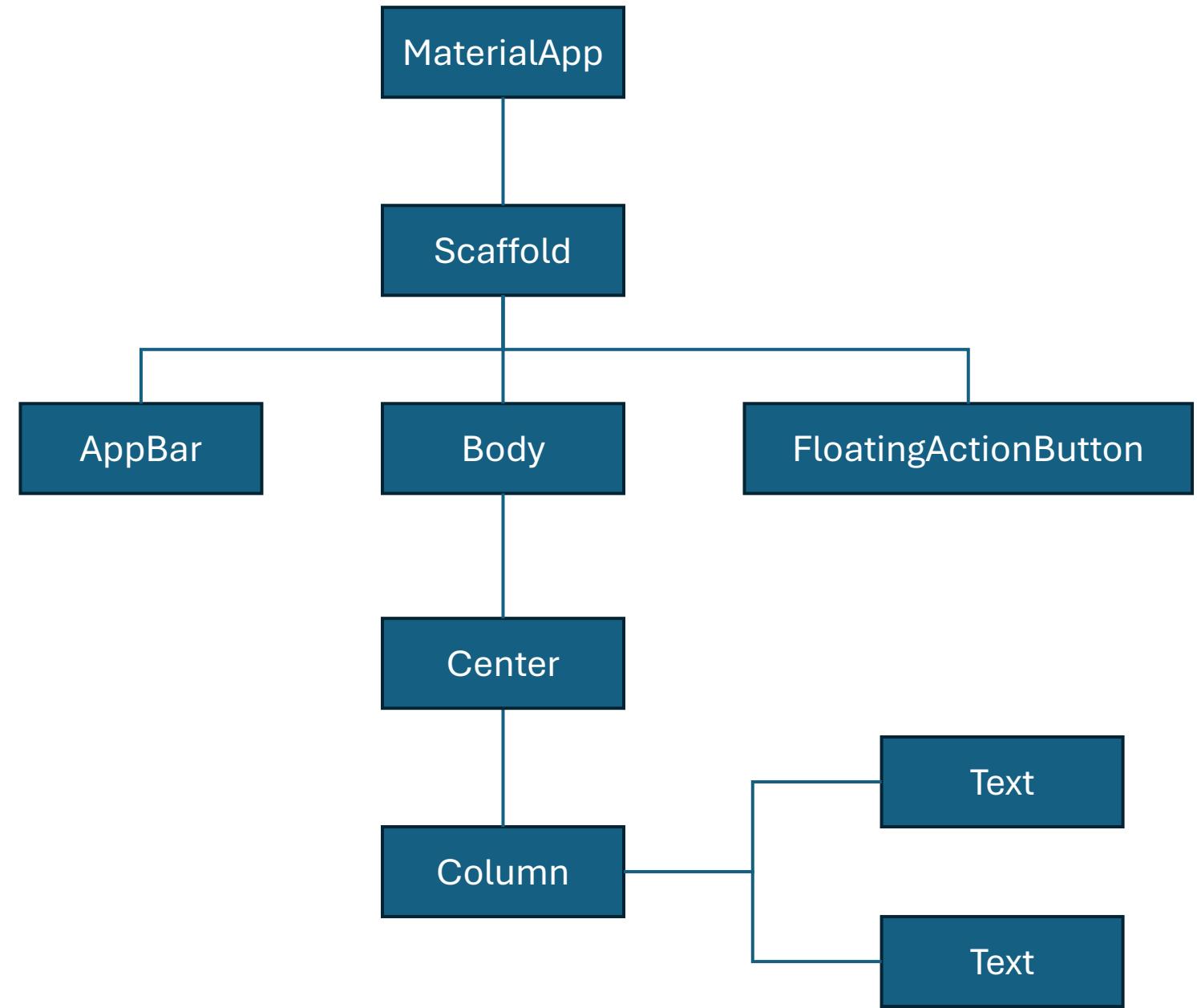
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[amaalik@psu.edu.sa](mailto:amaalik@psu.edu.sa)

# “Everything is a Widget”

- **Building blocks** of app's UI
- **Immutable** declaration of part of the UI
- Describe all aspects of a UI
  - **Physical Aspects** like text, button, ...
  - **Layout Aspects** like arrangement, padding, alignment,...
- A hierarchy based on composition



# Composition Hierarchy



# Scaffold Class

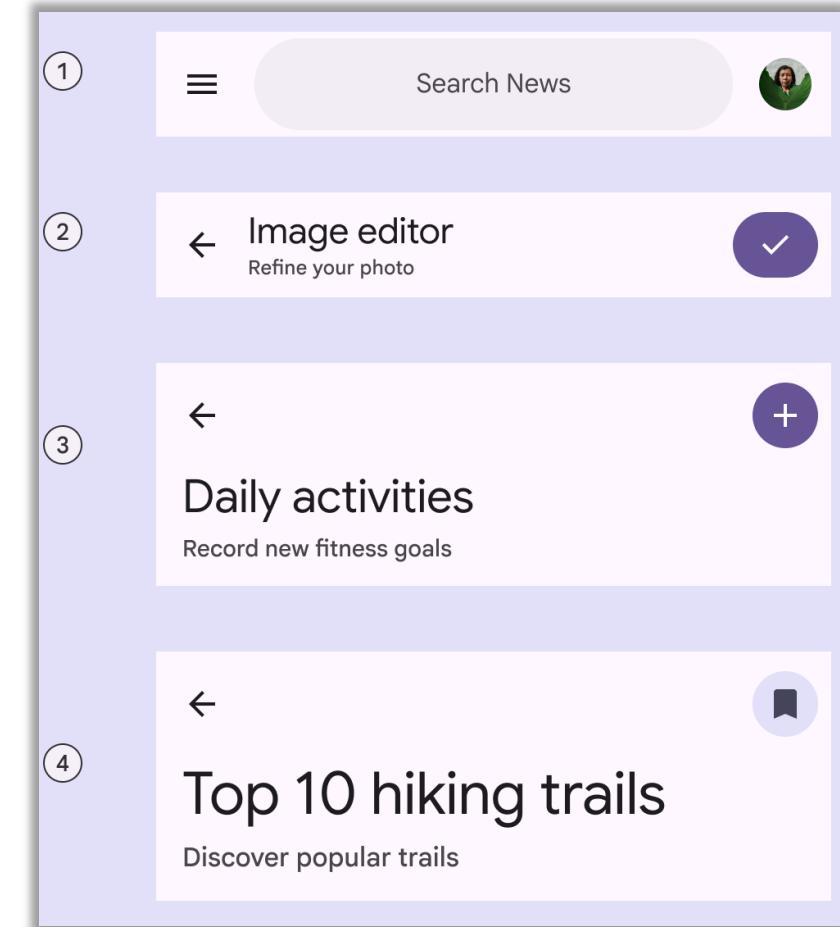
- Material Design visual **layout structure**
- AppBar
- Body - main components of App's UI
- BottomNavigationBar
- BottomSheet
- Drawer
- EndDrawer
- FloatingActionButton

# Scaffold - App Bar

- Focus on describing the current page and provide 1-2 essential actions
- Displays labels and page navigation controls
- Four types: Search app bar, small, medium flexible, large flexible

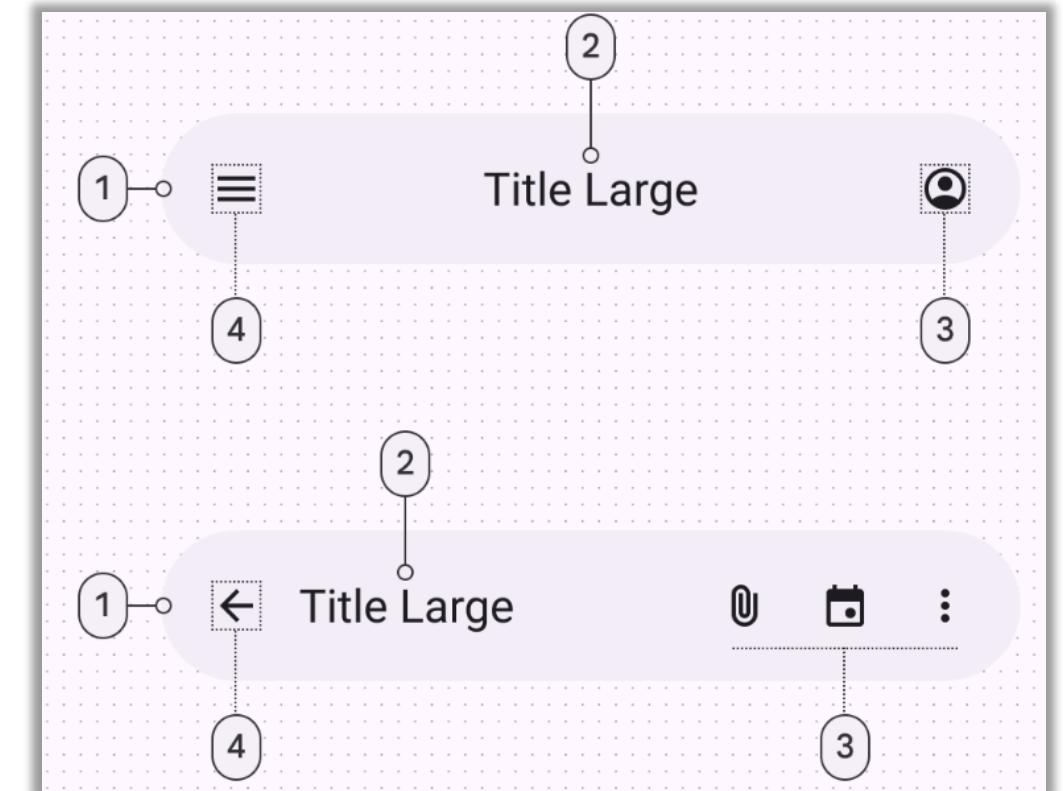
# Scaffold - App Bar

1. Search app bar
2. Small
3. Medium flexible
4. Large flexible



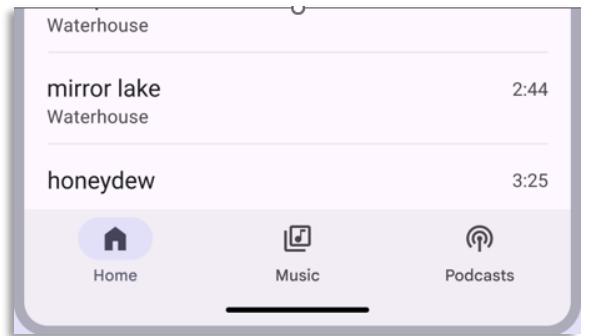
# Scaffold - App Bar

1. Container
2. Heading
3. Trailing Icon(s)
4. Leading Icon

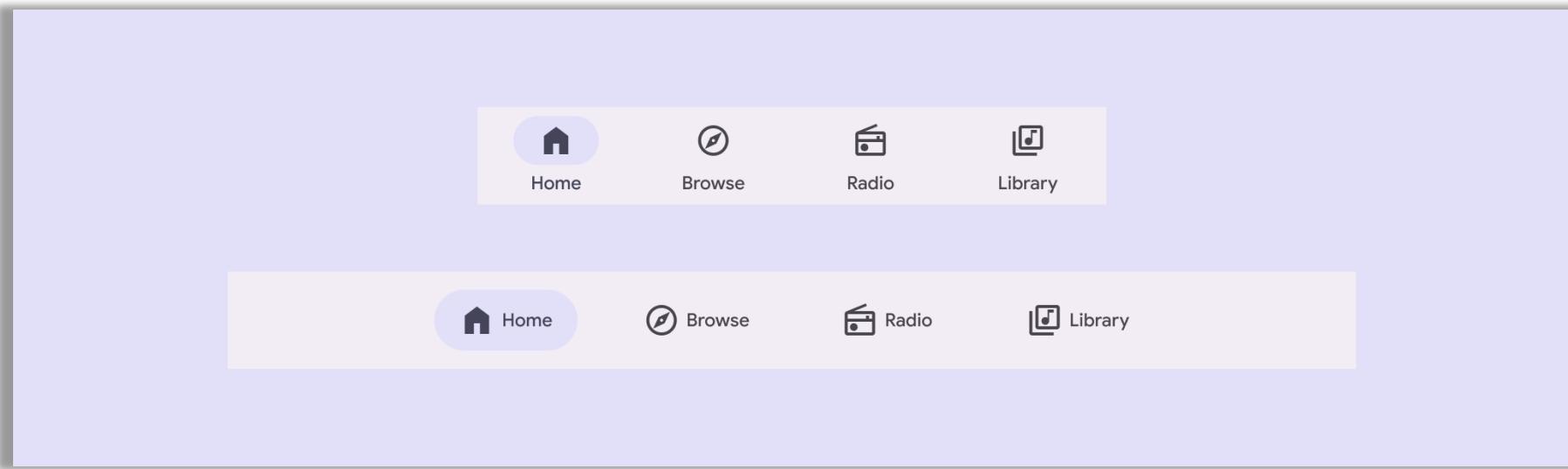


[Learn More](#)

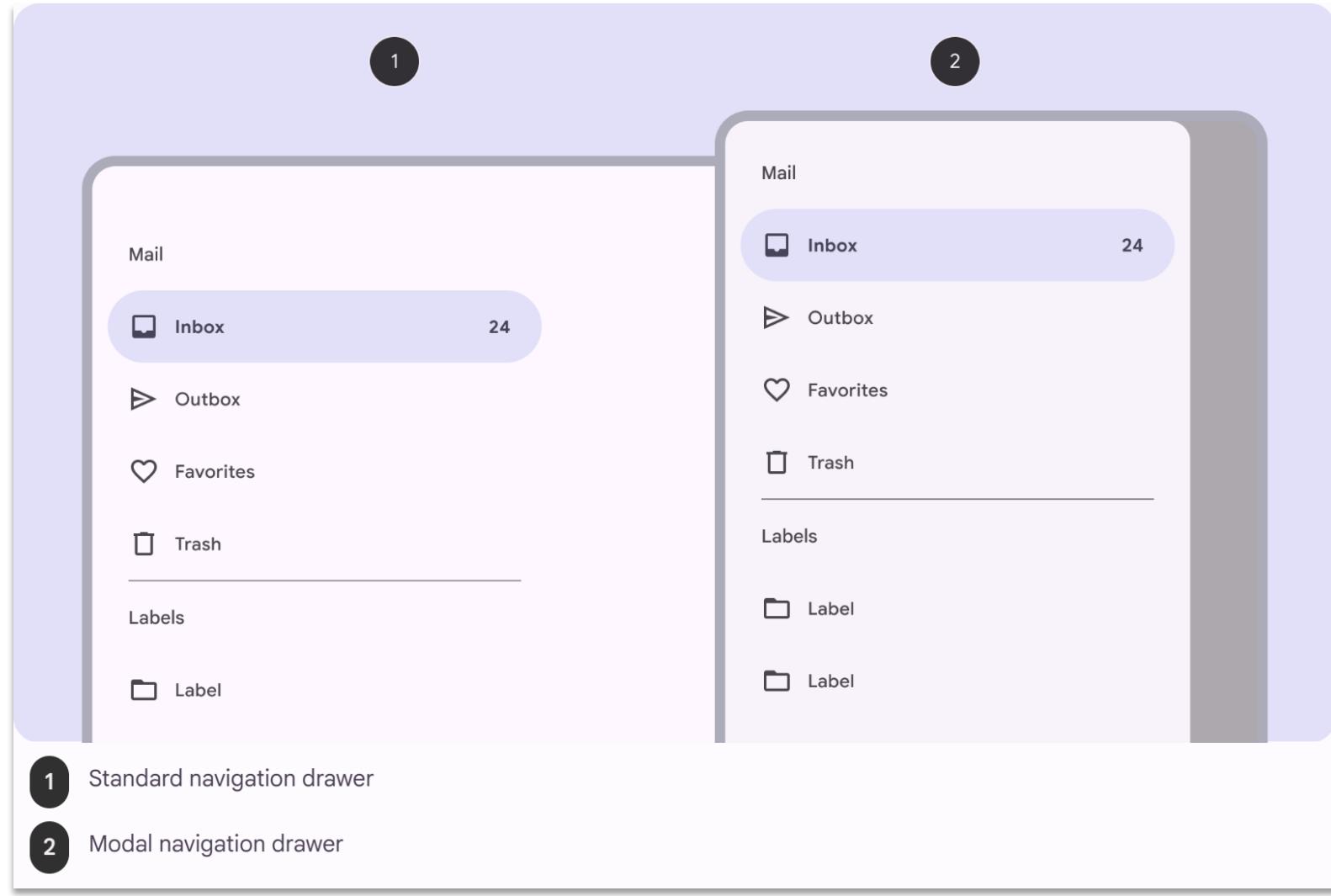
# Scaffold - Navigation Bar



- Contain 3-5 destinations of equal importance
- Destinations don't change. They should be consistent across app screens/pages.

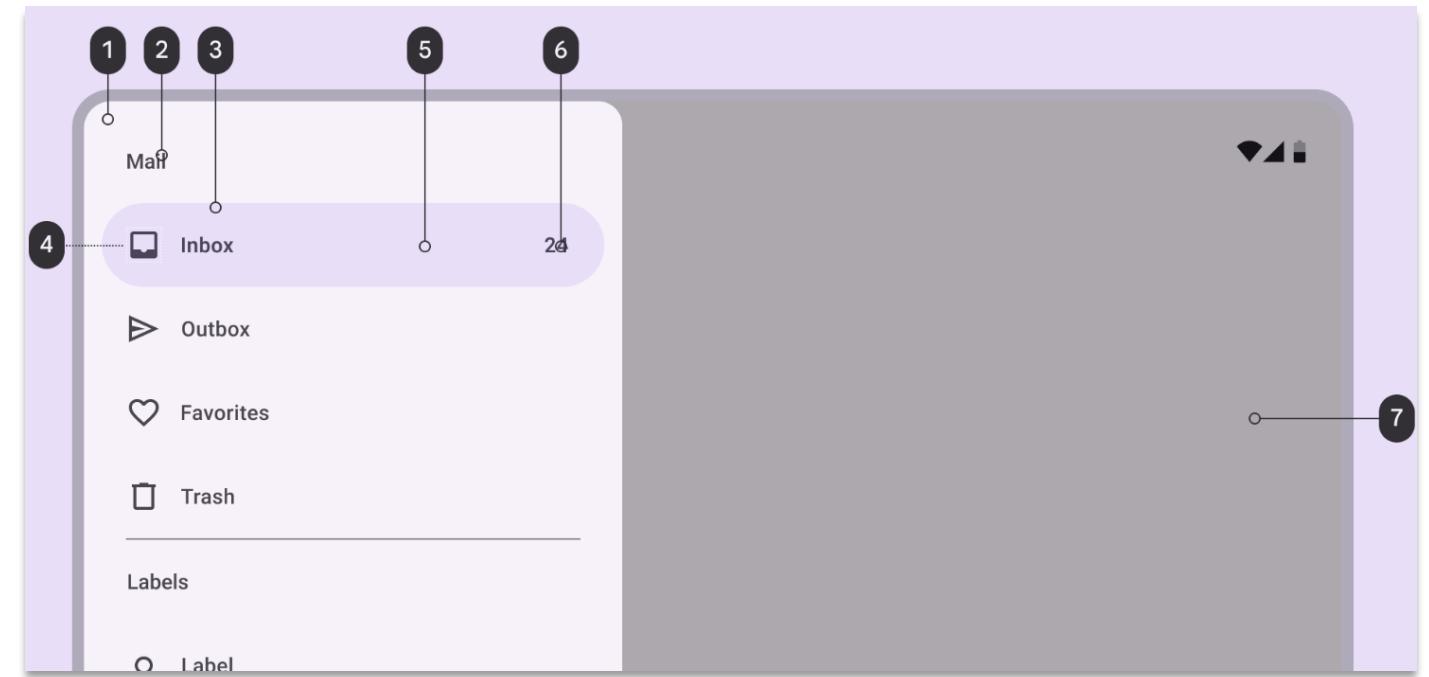


# Scaffold - Navigation Drawer



# Scaffold - Navigation Drawer

1. Container
2. Heading
3. Label Text
4. Icon
5. Active Indicator
6. Badge Label Text
7. Scrim



[Learn More](#)

# Scaffold - Bottom Sheet

- Addition or secondary content

1. Standard
2. Modal

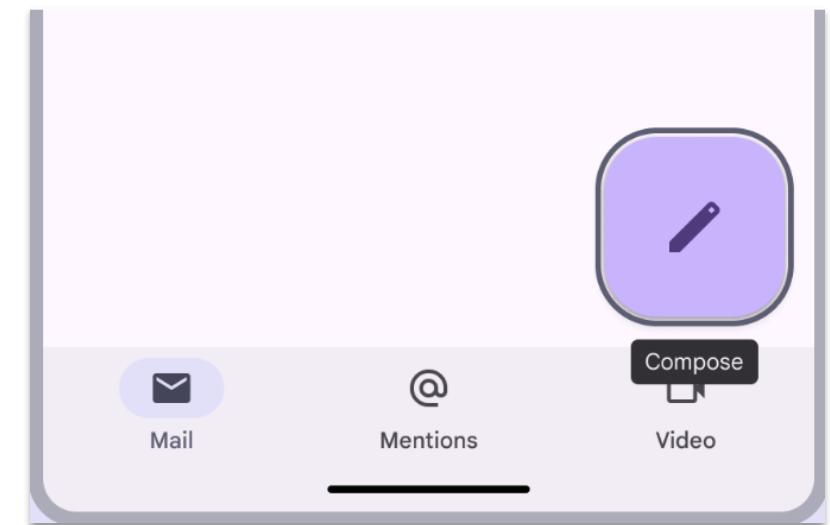


[Learn More](#)

# Scaffold - FAB

People should be able to do the following using assistive technology:

- Navigate to and activate FAB
- Perform an action



[Learn More](#)

# Widget Types

## Stateless Widget



## Stateful Widget



# Stateless Widget



<https://www.youtube.com/watch?v=wE7khGHVkYY>

# Stateful Widget

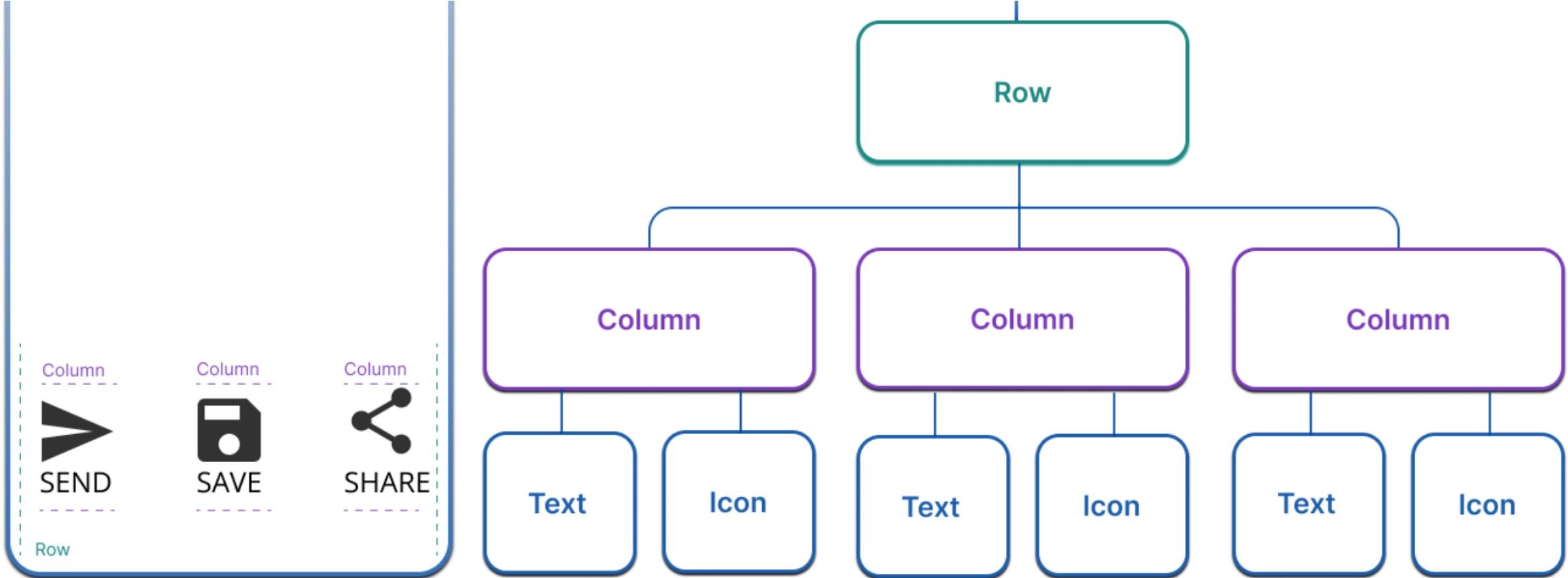


<https://www.youtube.com/watch?v=AqCMFXEmf3w>

# Layout

- Size and Position
- Layout models are Widgets
- Rows, columns and grids - layout widgets that arrange, constrain and align visible Widgets
- Column - arrange elements in a vertical direction
- Row - arrange elements in a horizontal direction

# Layout



# Layout - Constraints

- **Size and Position** of any widget are constrained by its **Parent**
  - Can't have any size
  - Can't decide its own position
- Size and position determined in cooperation with Parent
- A constraint is a set of 4 doubles: **a minimum and maximum width**, and **a minimum and maximum height**.

# Box Types

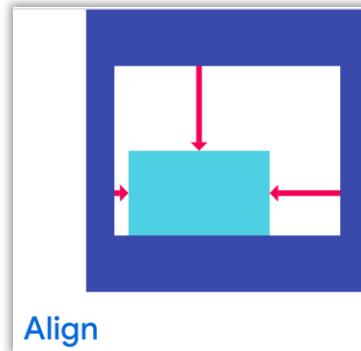
- Widgets are rendered by RenderBox
- Three Kinds
  1. Try to be as big as possible, e.g. Center, ListView
  2. Same size as child, e.g. Transform, Opacity
  3. Try to be a specific size, e.g. Image, Text

# Box Types

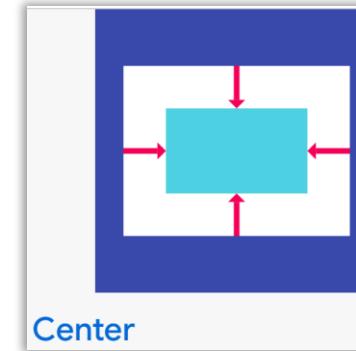
- Container - vary from type to type based on constructor arguments - default as big as possible
- Row and Column - vary based on constraints they are given

# Single-Child Layout Widgets

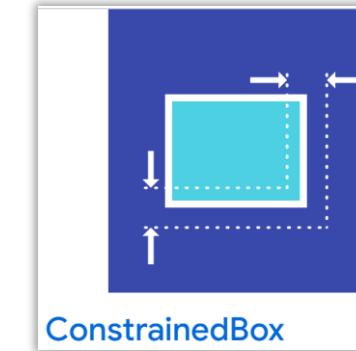
- Apply layout to one and only child



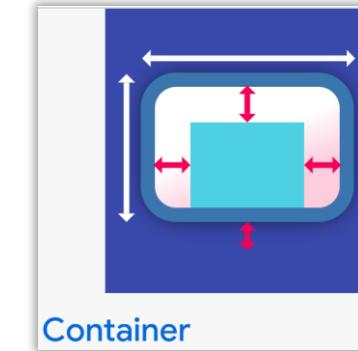
Align



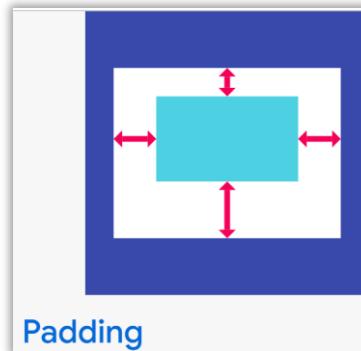
Center



ConstrainedBox



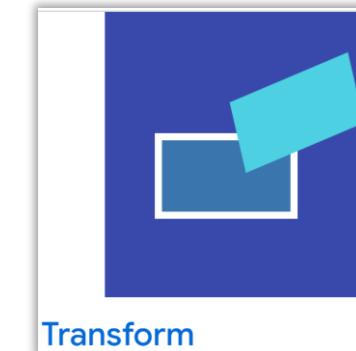
Container



Padding



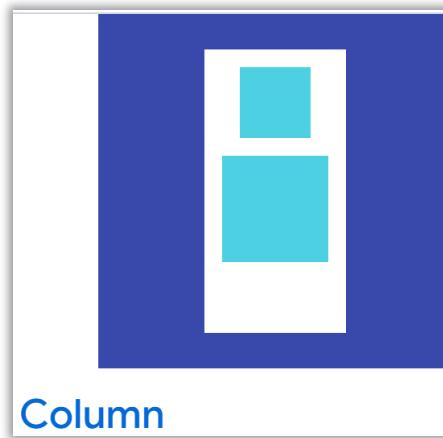
SizedBox



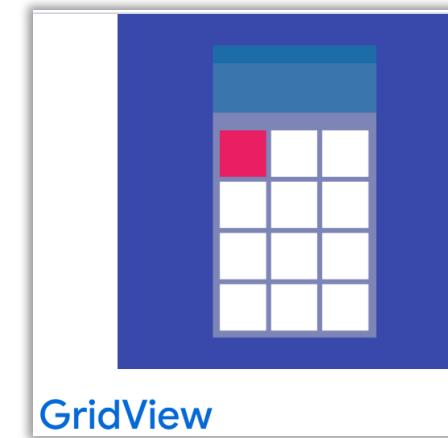
Transform

# Multi-Child Layout Widgets

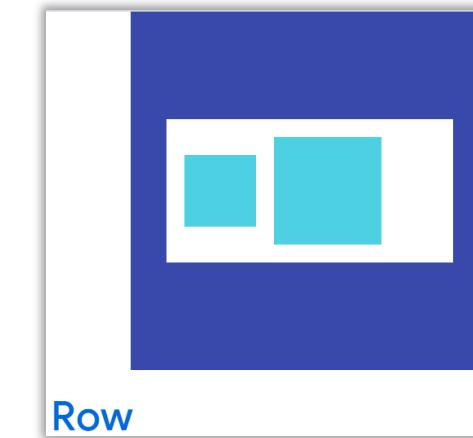
- Apply layout to its children



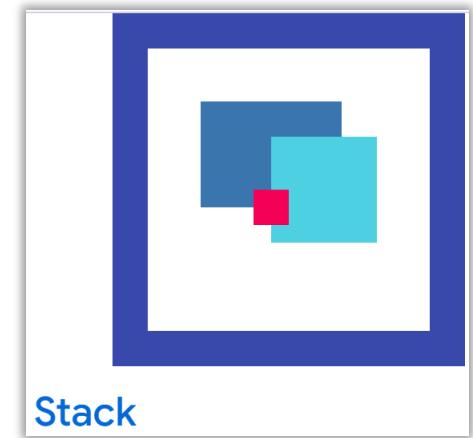
Column



GridView



Row



Stack

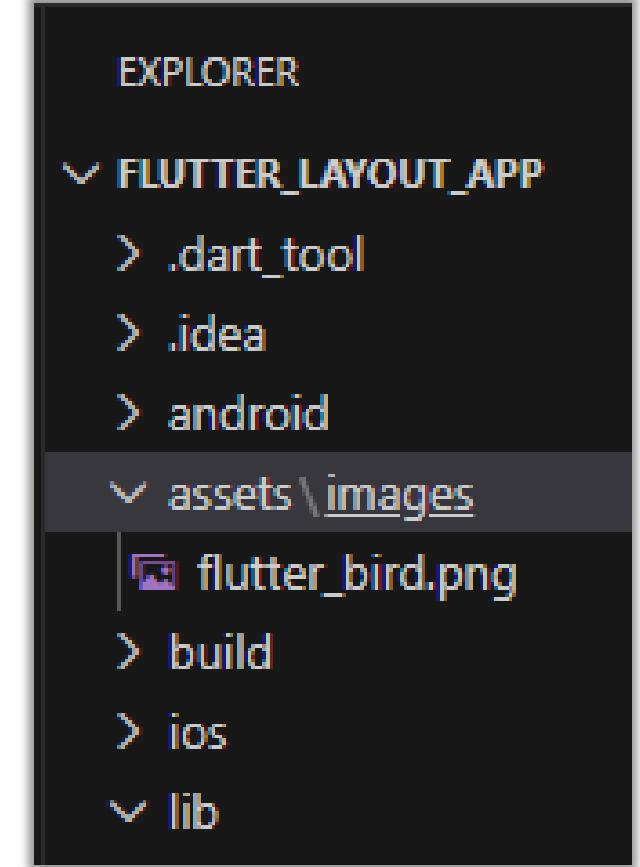
More on Layout Widgets

# Create a StatelessWidget BorderedImage



## Adding Assets in Project

- Create a new folder in your project "assets"
- Create another folder in "assets" folder "images"
- Copy an image in the images folder.  
Try to find a square image online.



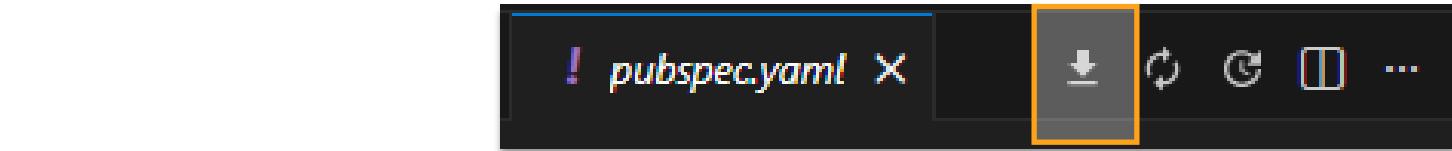
<https://flutter.dev/brand>

# Create a StatelessWidget BorderedImage

- Open the pubspec.yaml file and edit it
- Uncomment the asset section and edit as here

```
# To add assets to your application, add an assets section, like this:  
assets:  
  - assets/images/
```

## flutter pub get



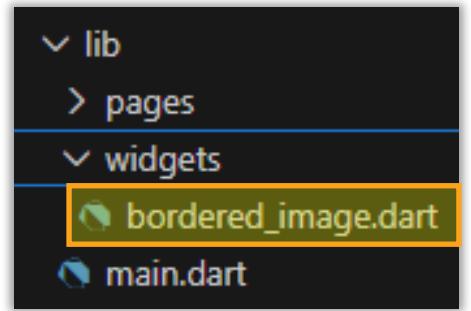
```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS  
  
malik@DESKTOP-HVT445C MINGW64 /d/Teaching/IS487 Mobile Development/Code/flutter_layout_app  
$ flutter pub get  
Downloading packages...  
  characters 1.4.0 (1.4.1 available)  
  matcher 0.12.17 (0.12.18 available)  
  material_color_utilities 0.11.1 (0.13.0 available)  
  test_api 0.7.7 (0.7.8 available)  
Got dependencies!  
4 packages have newer versions incompatible with dependency constraints.  
Try `flutter pub outdated` for more information.
```

### bordered\_image.dart X

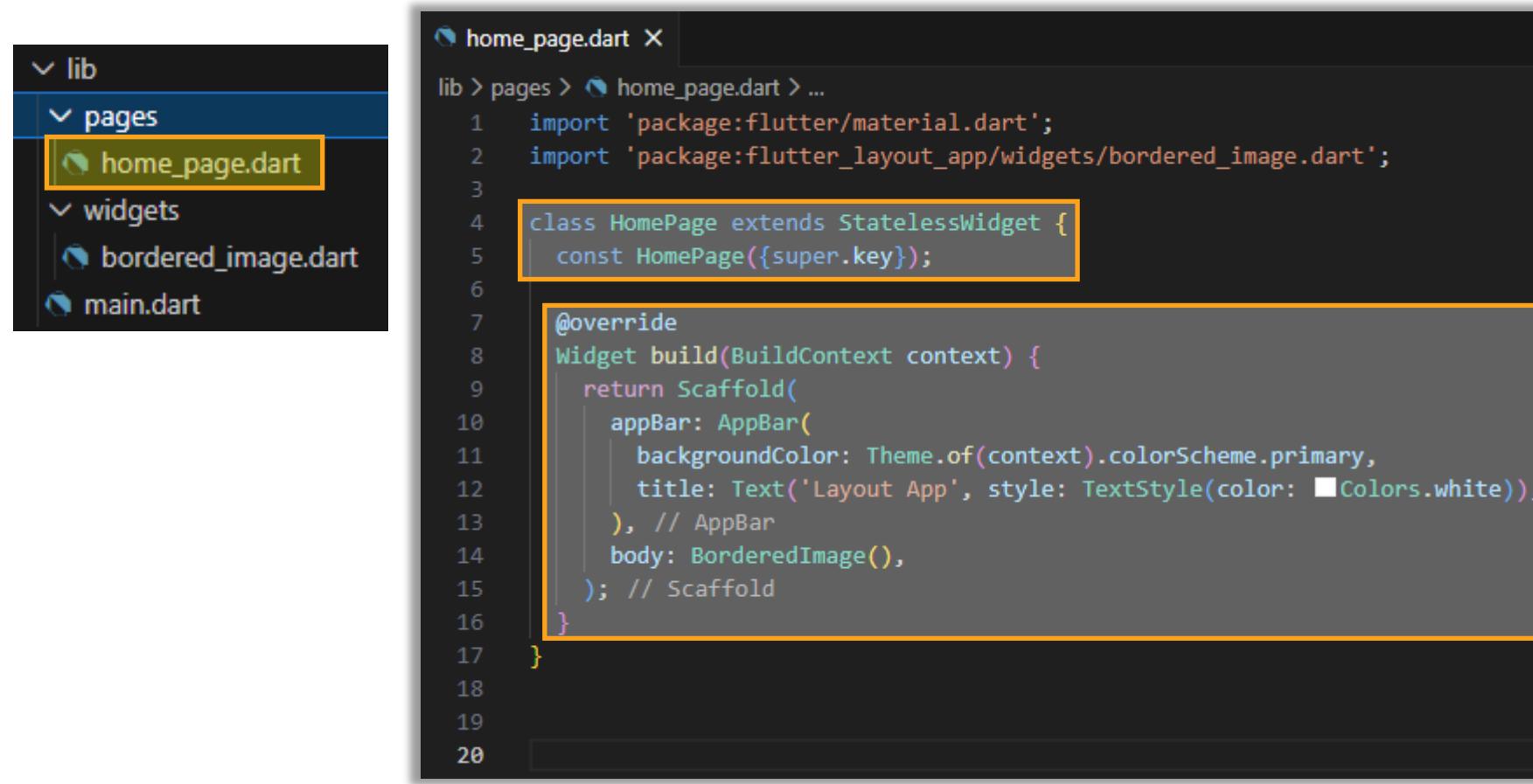
```
lib > widgets > bordered_image.dart > ...
1   import 'package:flutter/material.dart';
2
3   class BorderedImage extends StatelessWidget {
4     final double borderWidth;
5     final Color borderColor;
6     final double borderRadius;
7     final double imageSize;
8
9     const BorderedImage({
10       super.key,
11       this.borderWidth = 2.0,
12       this.borderColor = Colors.blueGrey,
13       this.borderRadius = 20,
14       this.imageSize = 100.0,
15     });
16
17   @override
18   Widget build(BuildContext context) {
19     return Container(
20       width: imageSize + (borderWidth * 2),
21       height: imageSize + (borderWidth * 2),
22       decoration: BoxDecoration(
23         border: Border.all(color: borderColor, width: borderWidth),
24         borderRadius: BorderRadius.circular(borderRadius),
25       ), // BoxDecoration
26       child: Image.asset(
27         'assets/images/flutter_bird.png',
28         width: imageSize,
29         height: imageSize,
30       ), // Image.asset
31     ); // Container
32   }
33 }
```

Container

# Create a Stateless Widget **BorderedImage**

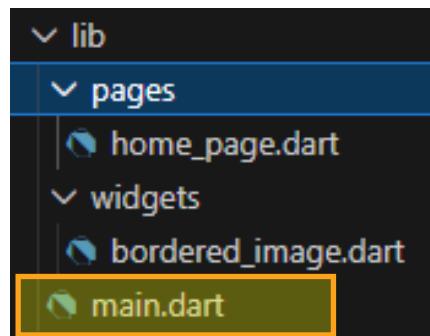


# HomePage



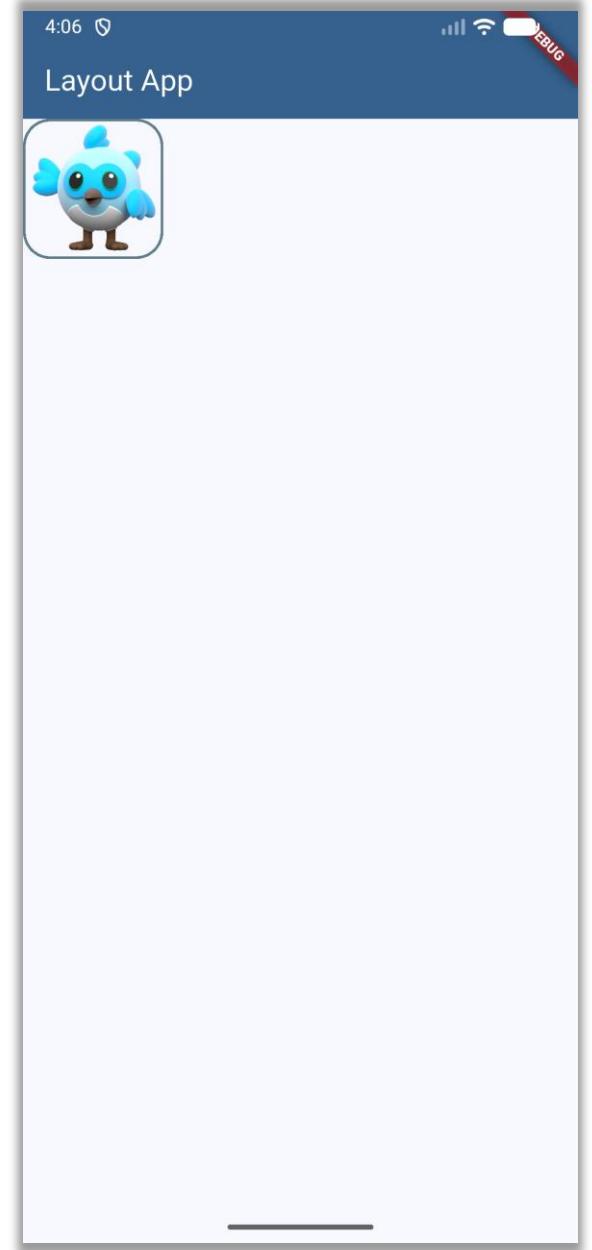
```
lib>pages>home_page.dart > ...
1 import 'package:flutter/material.dart';
2 import 'package:flutter_layout_app/widgets/bordered_image.dart';
3
4 class HomePage extends StatelessWidget {
5   const HomePage({super.key});
6
7   @override
8   Widget build(BuildContext context) {
9     return Scaffold(
10       appBar: AppBar(
11         backgroundColor: Theme.of(context).colorScheme.primary,
12         title: Text('Layout App', style: TextStyle(color: Colors.white)),
13       ), // AppBar
14       body: BorderedImage(),
15     ); // Scaffold
16   }
17
18
19
20 }
```

# main.dart

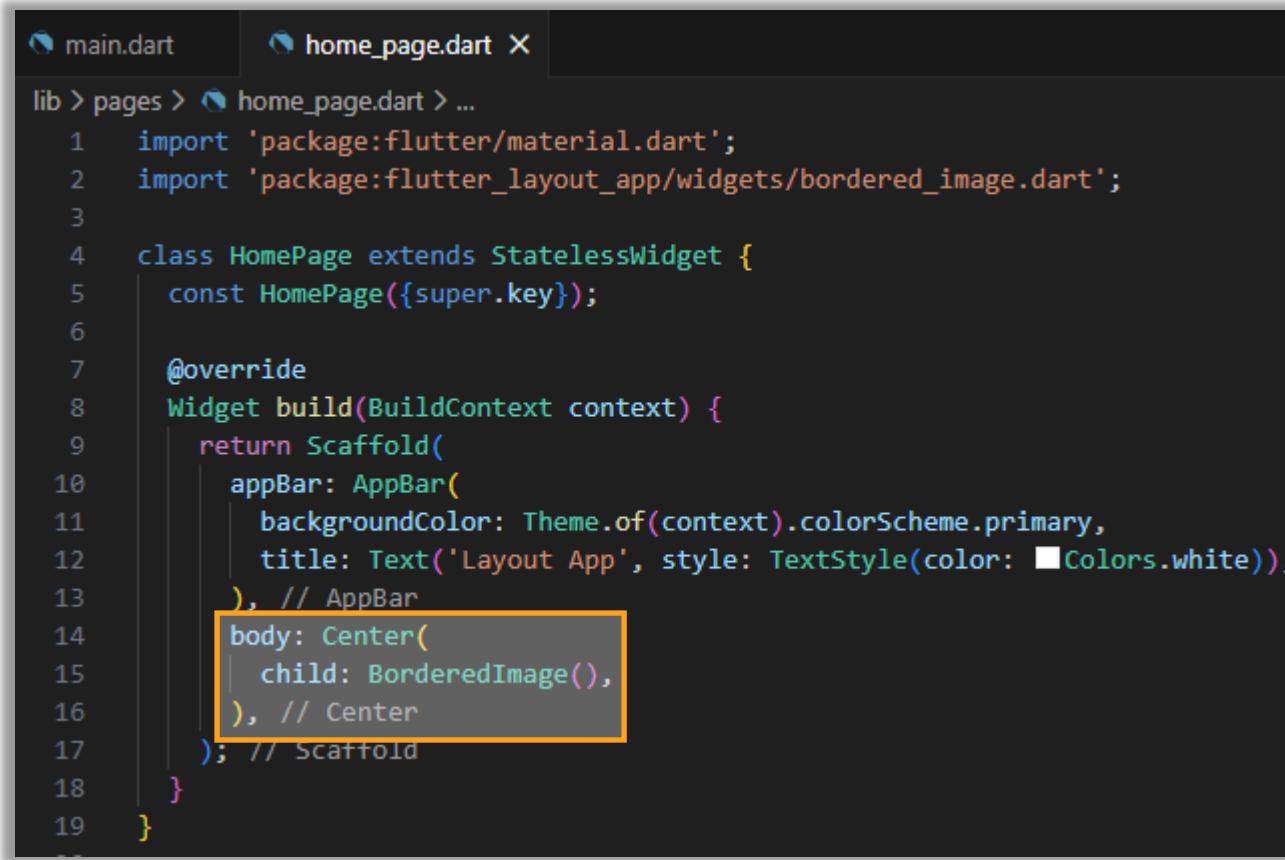


```
lib/main.dart X lib/home_page.dart

lib > lib/main.dart > ...
1 import 'package:flutter/material.dart';
2 import 'package:flutter_layout_app/pages/home_page.dart';
3
4 void main() {
5   runApp(const MyApp());
6 }
7
8 class MyApp extends StatelessWidget {
9   const MyApp({super.key});
10
11   // This widget is the root of your application.
12   @override
13   Widget build(BuildContext context) {
14     return MaterialApp(
15       title: 'Flutter Demo',
16       theme: ThemeData(
17         colorScheme: .fromSeed(seedColor: Colors.blue),
18       ), // ThemeData
19       home: const HomePage(),
20     ); // MaterialApp
21   }
22 }
```



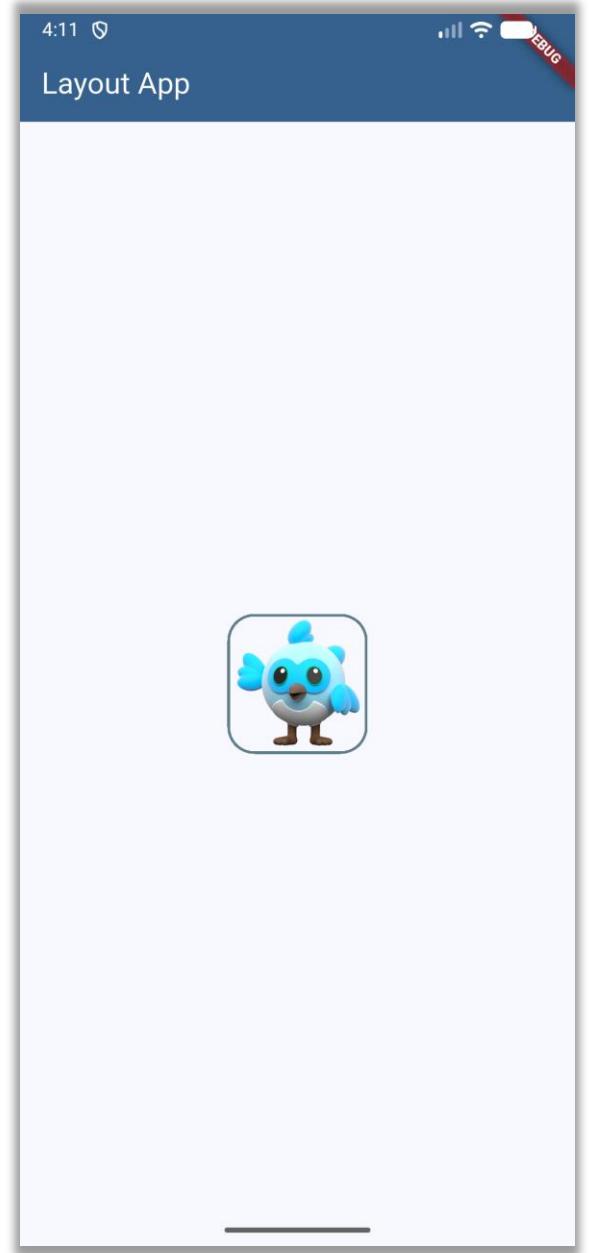
# Center Widget



```
main.dart    home_page.dart X

lib > pages > home_page.dart > ...
lib > pages > home_page.dart > ...
lib > pages > home_page.dart > ...

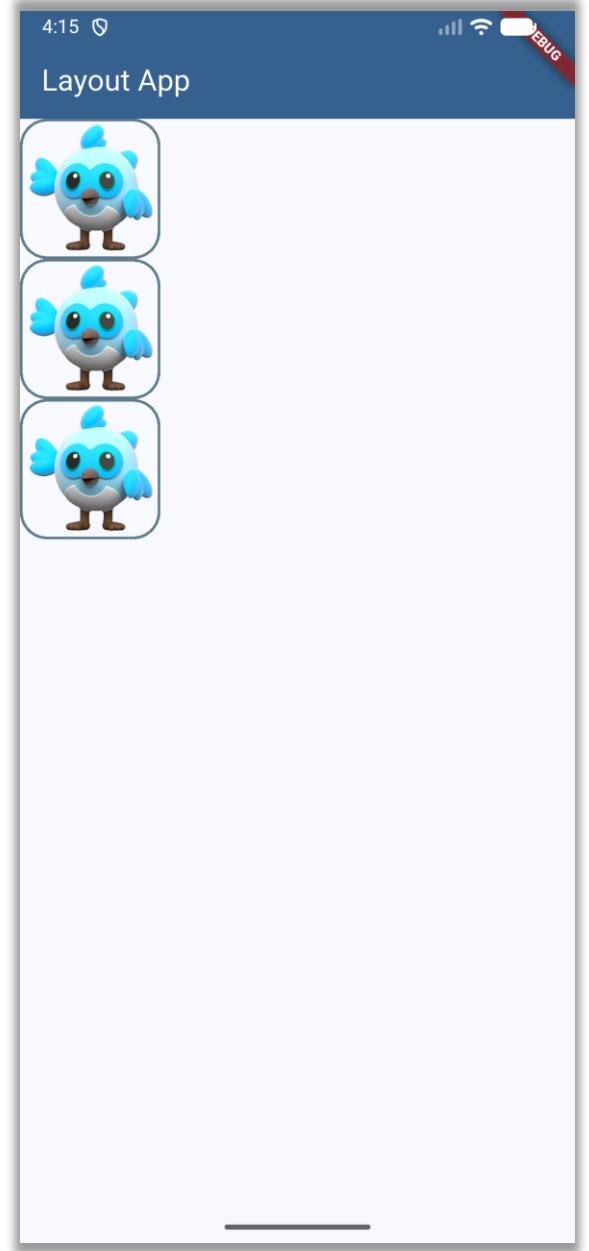
1 import 'package:flutter/material.dart';
2 import 'package:flutter_layout_app/widgets/bordered_image.dart';
3
4 class HomePage extends StatelessWidget {
5   const HomePage({super.key});
6
7   @override
8   Widget build(BuildContext context) {
9     return Scaffold(
10       appBar: AppBar(
11         backgroundColor: Theme.of(context).colorScheme.primary,
12         title: Text('Layout App', style: TextStyle(color: Colors.white)),
13       ), // AppBar
14       body: Center(
15         child: BorderedImage(),
16       ), // Center
17     ); // Scaffold
18   }
19 }
```



# Column Widget

```
main.dart          home_page.dart X

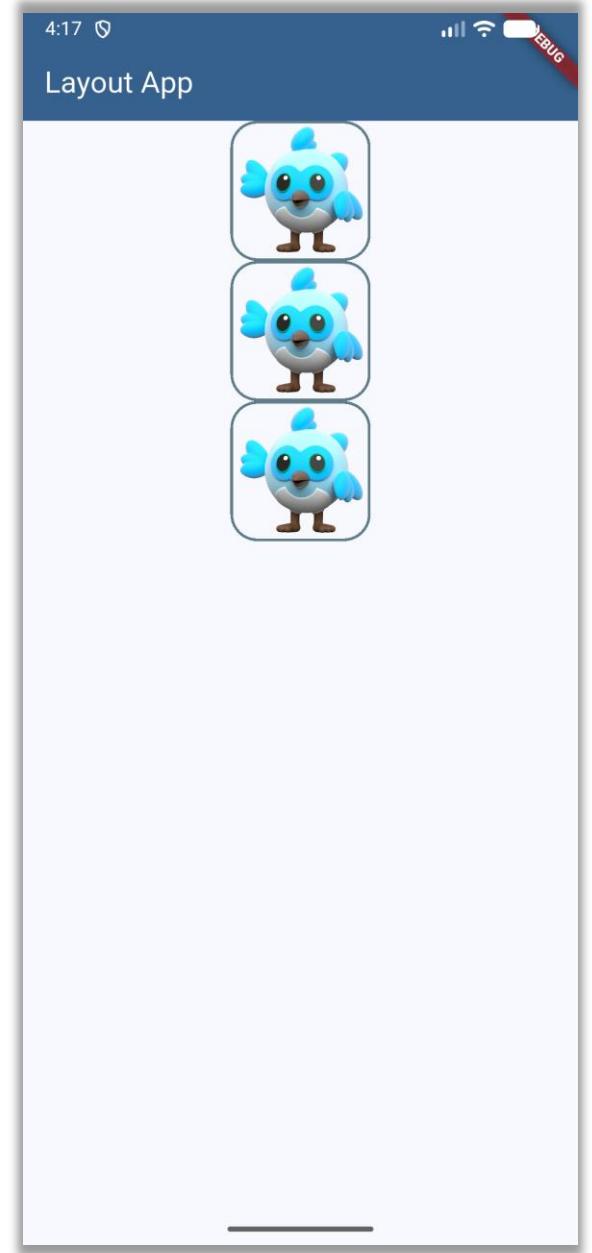
lib > pages > home_page.dart > ...
1 import 'package:flutter/material.dart';
2 import 'package:flutter_layout_app/widgets/bordered_image.dart';
3
4 class HomePage extends StatelessWidget {
5   const HomePage({super.key});
6
7   @override
8   Widget build(BuildContext context) {
9     return Scaffold(
10       appBar: AppBar(
11         backgroundColor: Theme.of(context).colorScheme.primary,
12         title: Text('Layout App', style: TextStyle(color: Colors.white)),
13       ), // AppBar
14       body: Column(
15         children: [BorderedImage(), BorderedImage(), BorderedImage()],
16       ), // Column
17     ); // Scaffold
18   }
19 }
```



# Center -> Column Widget

```
main.dart    home_page.dart X

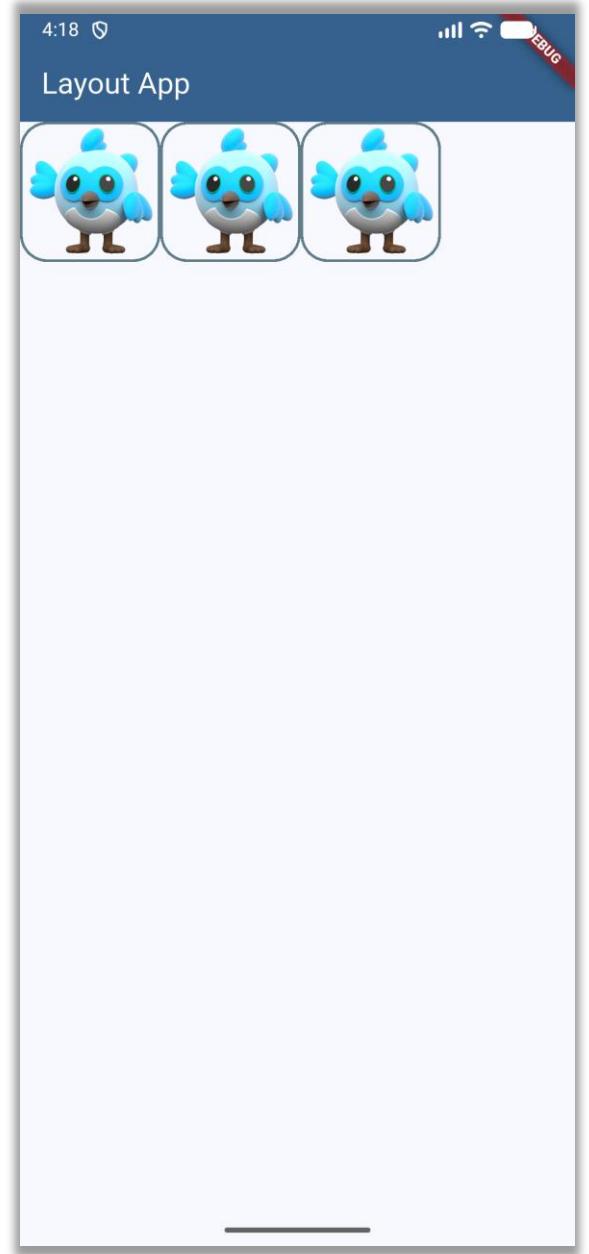
lib > pages > home_page.dart > ...
1 import 'package:flutter/material.dart';
2 import 'package:flutter_layout_app/widgets/bordered_image.dart';
3
4 class HomePage extends StatelessWidget {
5   const HomePage({super.key});
6
7   @override
8   Widget build(BuildContext context) {
9     return Scaffold(
10       appBar: AppBar(
11         backgroundColor: Theme.of(context).colorScheme.primary,
12         title: Text('Layout App', style: TextStyle(color: Colors.white)),
13       ), // AppBar
14       body: Center(
15         child: Column(
16           children: [BorderedImage(), BorderedImage(), BorderedImage()],
17         ), // Column
18       ), // Center
19     ); // Scaffold
20   }
21 }
```



# Row Widget

```
main.dart          home_page.dart X

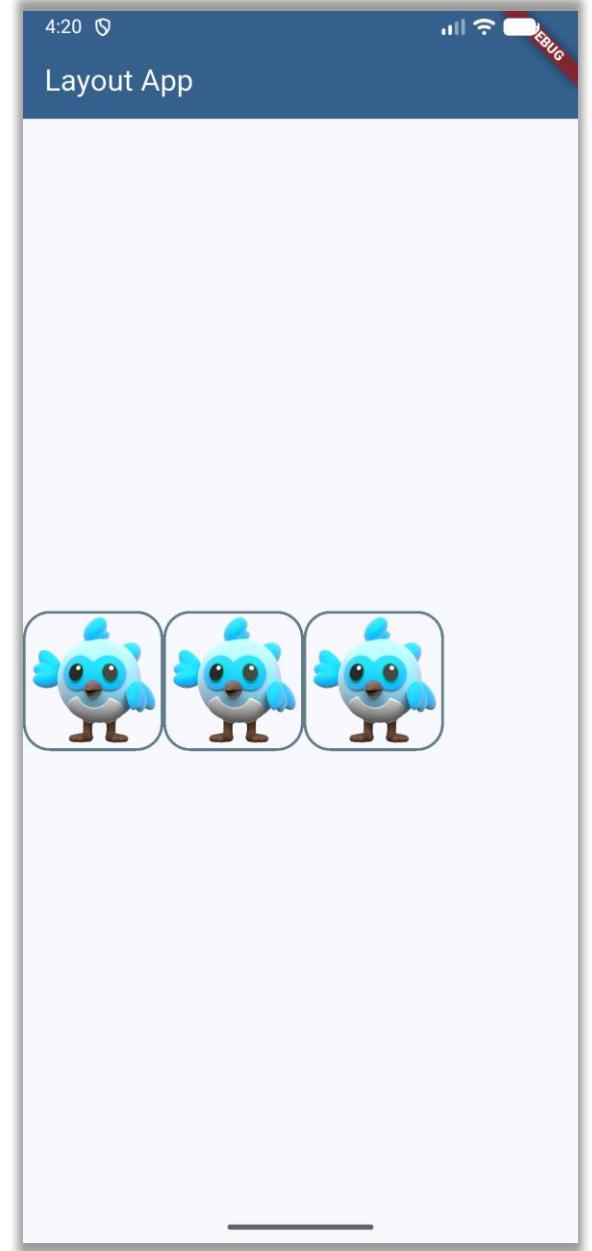
lib > pages > home_page.dart > ...
1   import 'package:flutter/material.dart';
2   import 'package:flutter_layout_app/widgets/bordered_image.dart';
3
4   class HomePage extends StatelessWidget {
5     const HomePage({super.key});
6
7     @override
8     Widget build(BuildContext context) {
9       return Scaffold(
10         appBar: AppBar(
11           backgroundColor: Theme.of(context).colorScheme.primary,
12           title: Text('Layout App', style: TextStyle(color: Colors.white)),
13         ), // AppBar
14         body: Row(
15           children: [BorderedImage(), BorderedImage(), BorderedImage()],
16         ), // Row
17       ); // Scaffold
18     }
19 }
```



# Center -> Row Widget

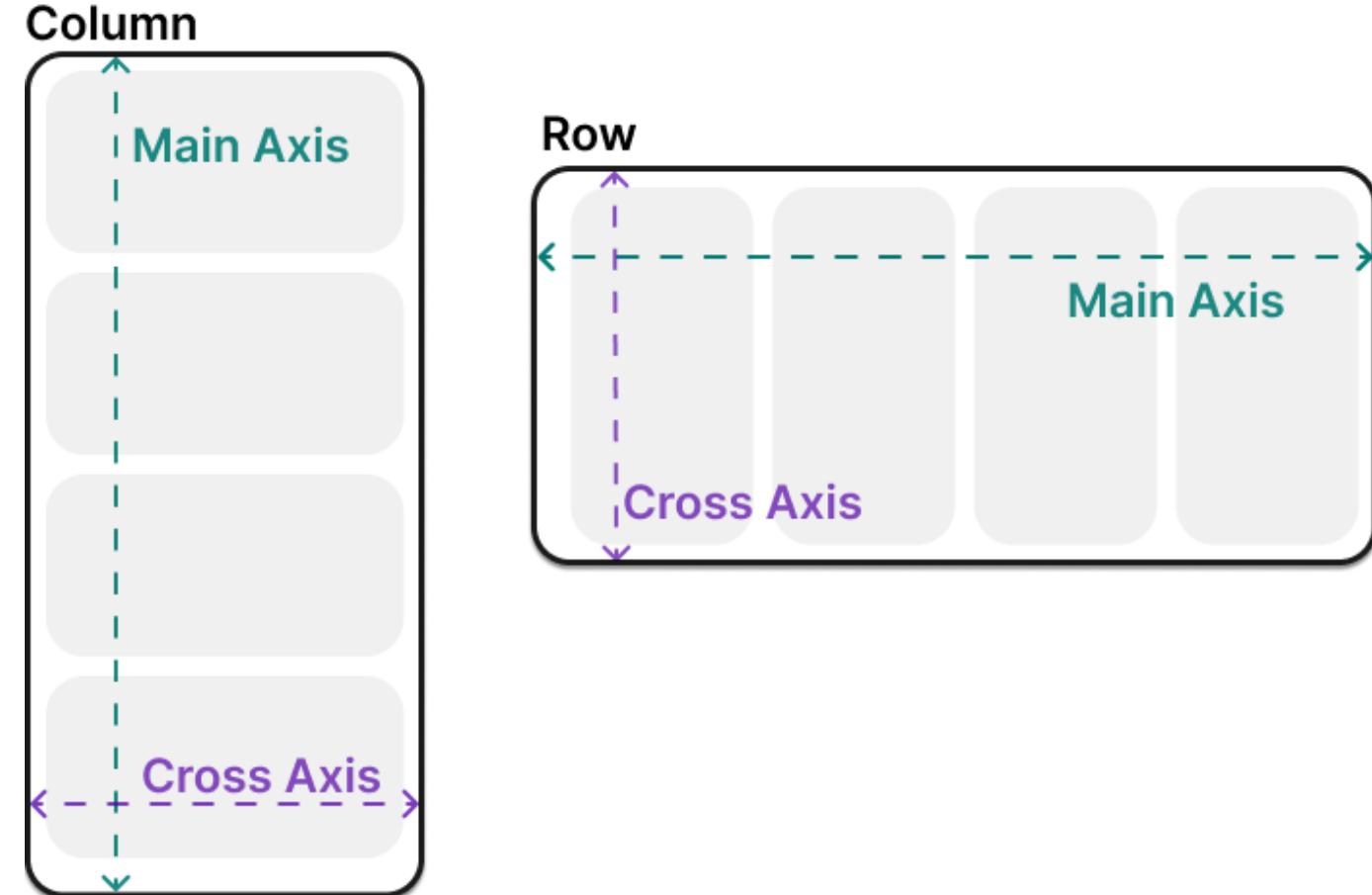
```
main.dart          home_page.dart X

lib > pages > home_page.dart > ...
1 import 'package:flutter/material.dart';
2 import 'package:flutter_layout_app/widgets/bordered_image.dart';
3
4 class HomePage extends StatelessWidget {
5   const HomePage({super.key});
6
7   @override
8   Widget build(BuildContext context) {
9     return Scaffold(
10       appBar: AppBar(
11         backgroundColor: Theme.of(context).colorScheme.primary,
12         title: Text('Layout App', style: TextStyle(color: Colors.white)),
13       ), // AppBar
14       body: Center(
15         child: Row(
16           children: [BorderedImage(), BorderedImage(), BorderedImage()],
17         ), // Row
18       ), // Center
19     ); // Scaffold
20   }
21 }
```



# Align Widgets within Rows and Columns

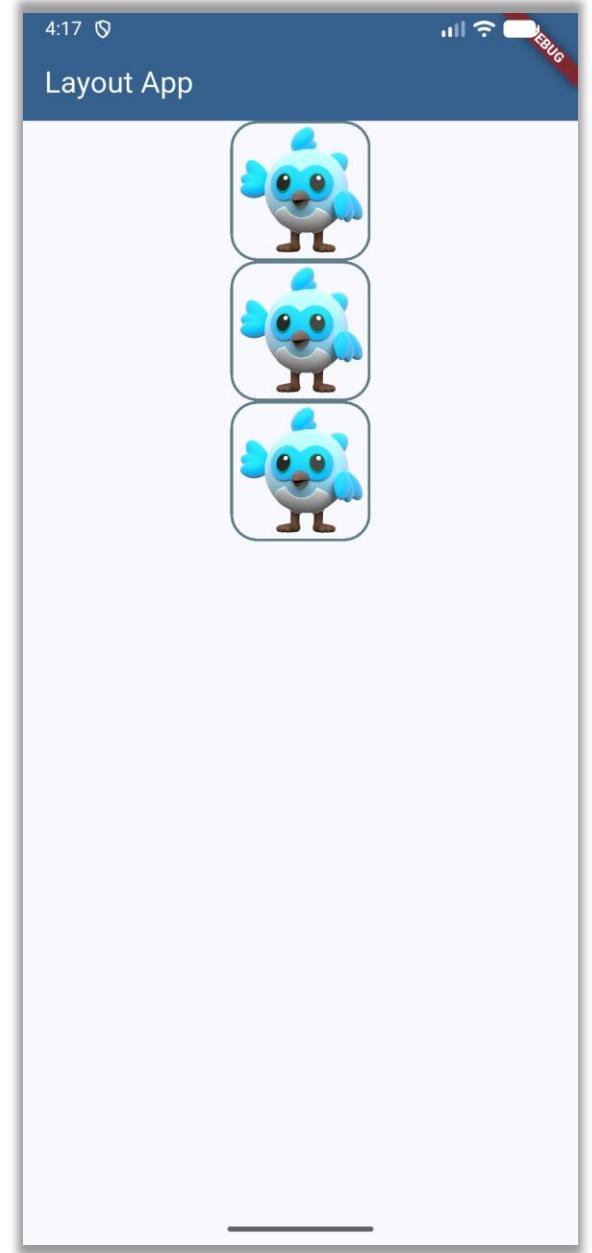
## Main Axis and Cross Axis



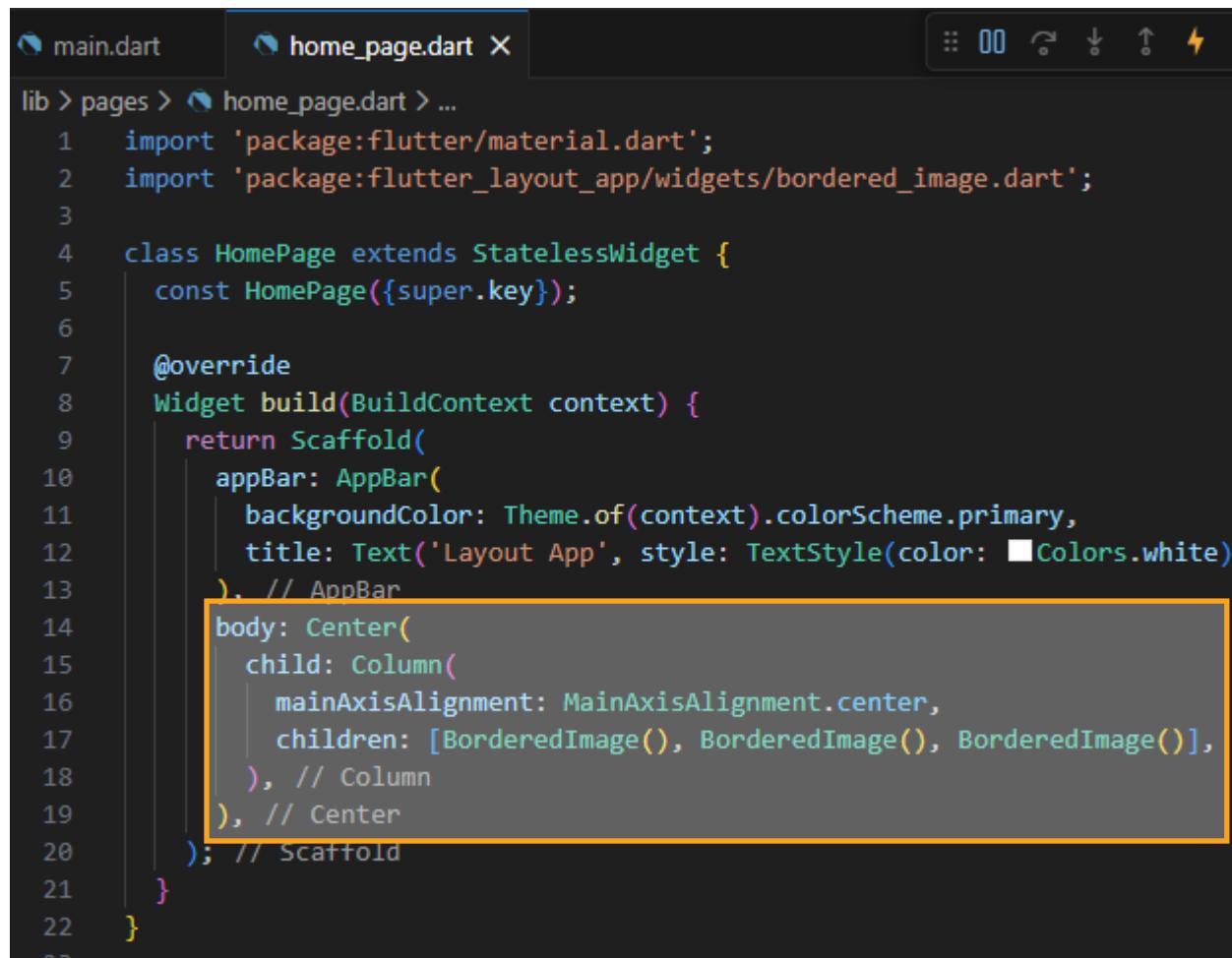
# Center -> Column Widget

```
main.dart    home_page.dart X

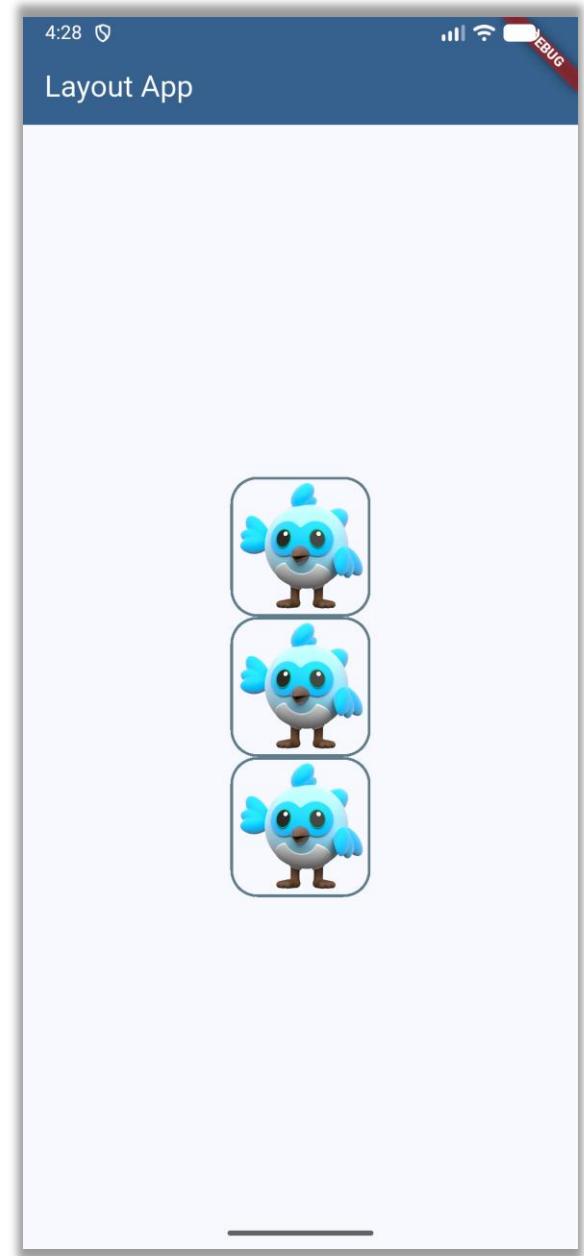
lib > pages > home_page.dart > ...
1 import 'package:flutter/material.dart';
2 import 'package:flutter_layout_app/widgets/bordered_image.dart';
3
4 class HomePage extends StatelessWidget {
5   const HomePage({super.key});
6
7   @override
8   Widget build(BuildContext context) {
9     return Scaffold(
10       appBar: AppBar(
11         backgroundColor: Theme.of(context).colorScheme.primary,
12         title: Text('Layout App', style: TextStyle(color: Colors.white)),
13       ), // AppBar
14       body: Center(
15         child: Column(
16           children: [BorderedImage(), BorderedImage(), BorderedImage()],
17         ), // Column
18       ), // Center
19     ); // Scaffold
20   }
21 }
```



# Center -> Column Widget mainAxisAlignment



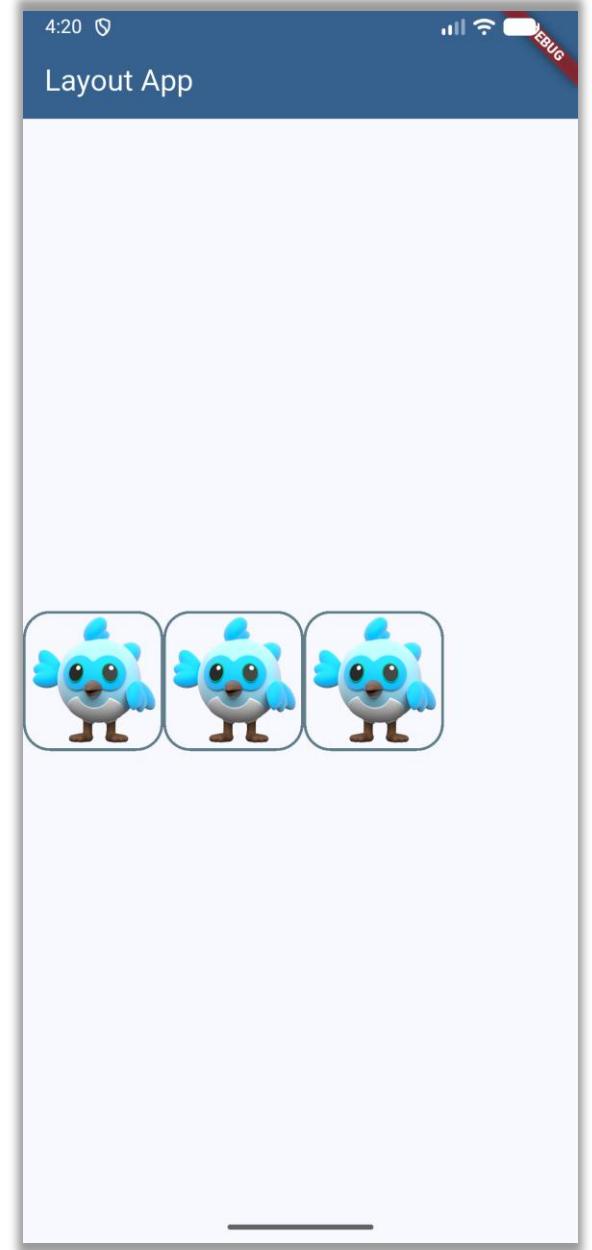
```
main.dart          home_page.dart X
lib > pages > home_page.dart > ...
1 import 'package:flutter/material.dart';
2 import 'package:flutter_layout_app/widgets/bordered_image.dart';
3
4 class HomePage extends StatelessWidget {
5   const HomePage({super.key});
6
7   @override
8   Widget build(BuildContext context) {
9     return Scaffold(
10       appBar: AppBar(
11         backgroundColor: Theme.of(context).colorScheme.primary,
12         title: Text('Layout App', style: TextStyle(color: Colors.white)),
13       ), // AppBar
14       body: Center(
15         child: Column(
16           mainAxisAlignment: MainAxisAlignment.center,
17           children: [BorderedImage(), BorderedImage(), BorderedImage()],
18         ), // Column
19       ), // Center
20     ); // Scaffold
21   }
22 }
```



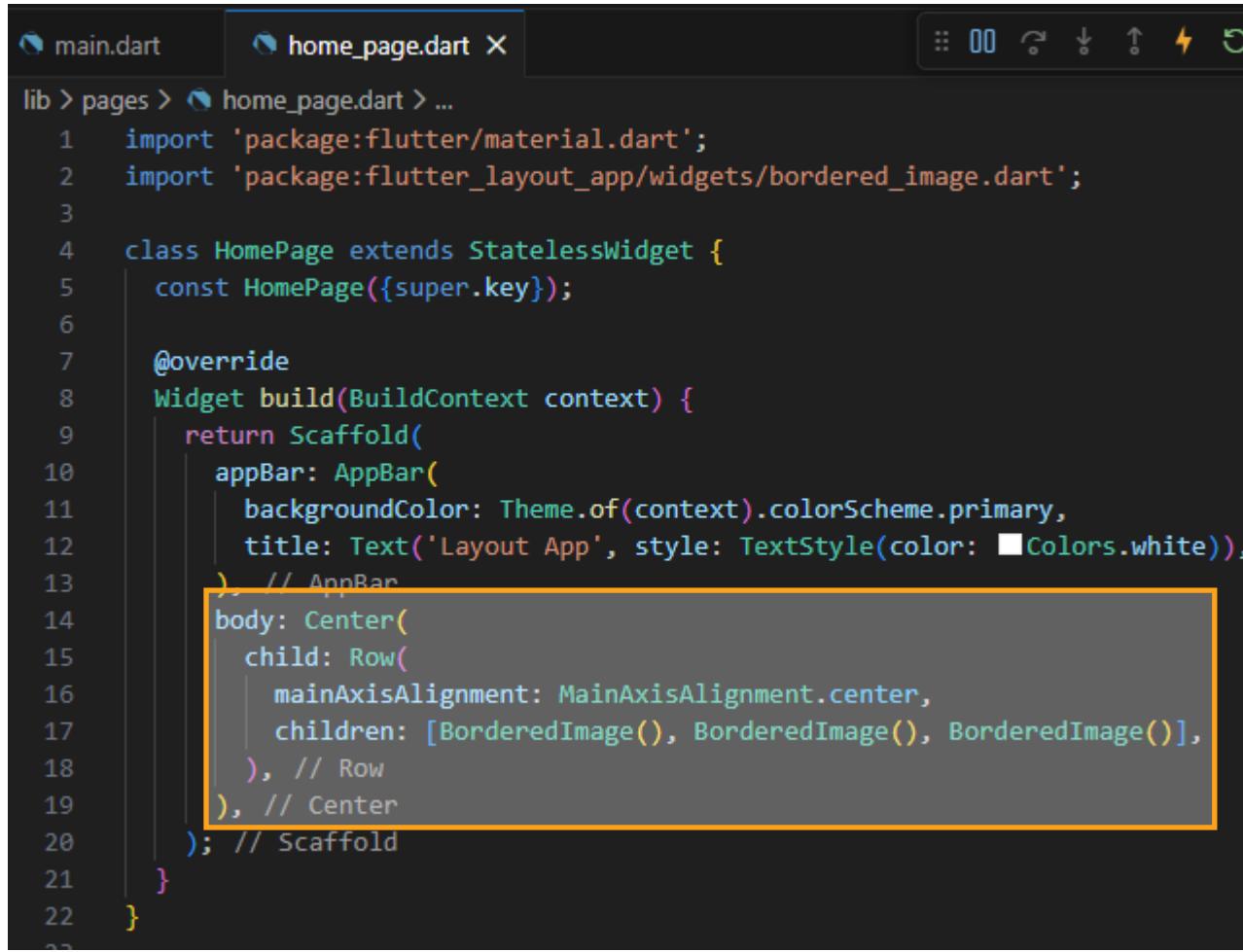
# Center -> Row Widget

```
main.dart          home_page.dart X

lib > pages > home_page.dart > ...
1 import 'package:flutter/material.dart';
2 import 'package:flutter_layout_app/widgets/bordered_image.dart';
3
4 class HomePage extends StatelessWidget {
5   const HomePage({super.key});
6
7   @override
8   Widget build(BuildContext context) {
9     return Scaffold(
10       appBar: AppBar(
11         backgroundColor: Theme.of(context).colorScheme.primary,
12         title: Text('Layout App', style: TextStyle(color: Colors.white)),
13       ), // AppBar
14       body: Center(
15         child: Row(
16           children: [BorderedImage(), BorderedImage(), BorderedImage()],
17         ), // Row
18       ), // Center
19     ); // Scaffold
20   }
21 }
```



# Center -> Row Widget mainAxisAlignment

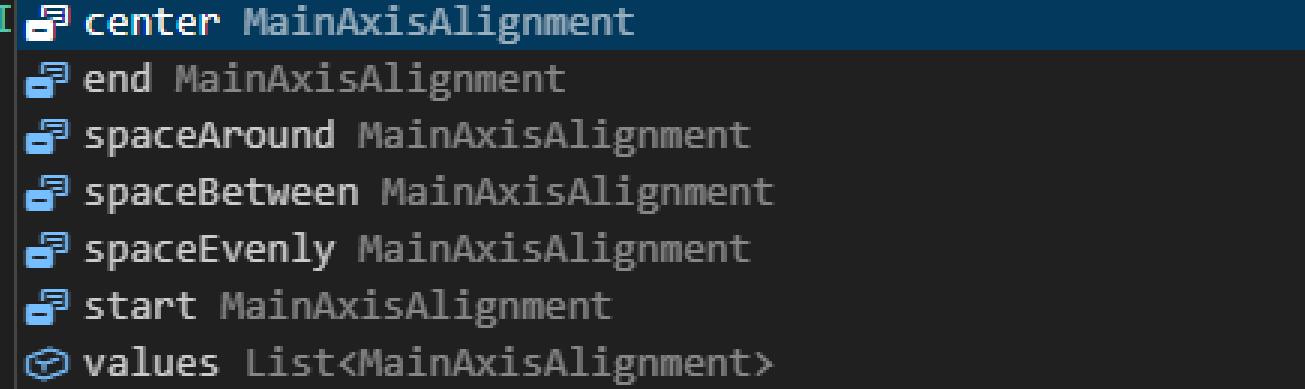


```
main.dart          home_page.dart X
lib > pages > home_page.dart > ...
1 import 'package:flutter/material.dart';
2 import 'package:flutter_layout_app/widgets/bordered_image.dart';
3
4 class HomePage extends StatelessWidget {
5   const HomePage({super.key});
6
7   @override
8   Widget build(BuildContext context) {
9     return Scaffold(
10       appBar: AppBar(
11         backgroundColor: Theme.of(context).colorScheme.primary,
12         title: Text('Layout App', style: TextStyle(color: Colors.white)),
13       ), // AppBar
14       body: Center(
15         child: Row(
16           mainAxisAlignment: MainAxisAlignment.center,
17           children: [BorderedImage(), BorderedImage(), BorderedImage()],
18         ), // Row
19       ), // Center
20     ); // Scaffold
21   }
22 }
```



# Other Options

```
body: Center(  
    child: Row(  
        mainAxisAlignment: MainAxisAlignment.x,  
        children: [BorderedImage(), BorderedI  
    ), // Row  
, // Center  
; // Scaffold
```



The screenshot shows a code editor with Dart code. A code completion dropdown is open at the end of the line `mainAxisAlignment: MainAxisAlignment.`. The dropdown contains the following options:

- center MainAxisAlignment
- end MainAxisAlignment
- spaceAround MainAxisAlignment
- spaceBetween MainAxisAlignment
- spaceEvenly MainAxisAlignment
- start MainAxisAlignment
- values List<MainAxisAlignment>

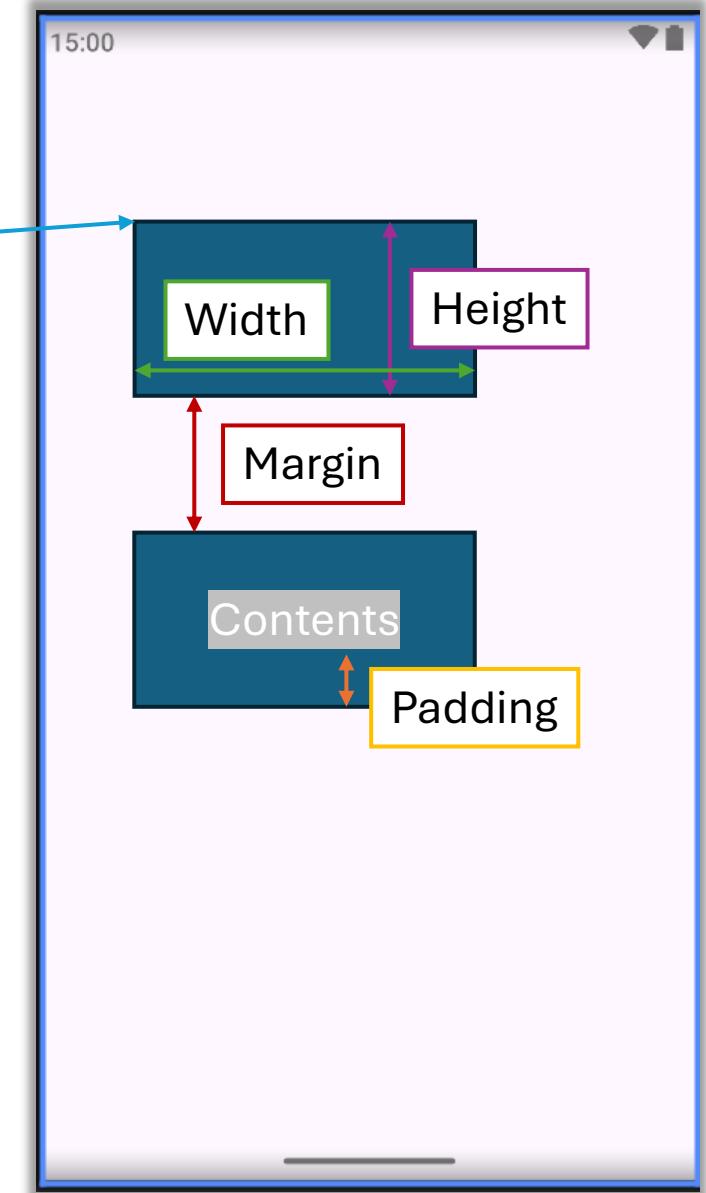
```
main.dart    home_page.dart X  bordered_image.dart  00  
lib > pages > home_page.dart > build  
1   import 'package:flutter/material.dart';  
2   import 'package:flutter_layout_app/widgets/bordered_image.dart';  
3  
4   class HomePage extends StatelessWidget {  
5       const HomePage({super.key});  
6  
7       @override  
8       Widget build(BuildContext context) {  
9           return Scaffold(  
10               appBar: AppBar(  
11                   backgroundColor: Theme.of(context).colorScheme.primary,  
12                   title: Text('Layout App', style: TextStyle(color: Colors.white)),  
13               ), // AppBar  
14               body: Container(  
15                   margin: EdgeInsets.all(8.0),  
16                   padding: EdgeInsets.all(8.0),  
17                   height: MediaQuery.of(context).size.height,  
18                   decoration: BoxDecoration(  
19                       border: Border.all(color: Colors.blue, width: 2),  
20                       borderRadius: BorderRadius.circular(20.0),  
21                   ), // BoxDecoration  
22                   child: Row(  
23                       mainAxisAlignment: MainAxisAlignment.spaceEvenly,  
24                       crossAxisAlignment: CrossAxisAlignment.center,  
25                       children: [BorderedImage(), BorderedImage(), BorderedImage()],  
26                   ), // Row  
27               ), // Container  
28           ); // Scaffold  
29       }  
30   }
```



# Box Model

- A rectangle box
- **Position:** left and top coordinate
- **Size:** two dimensions, width and height
- **Padding:** Empty space between contents and Border
- **Margin:** Empty Space between two widgets

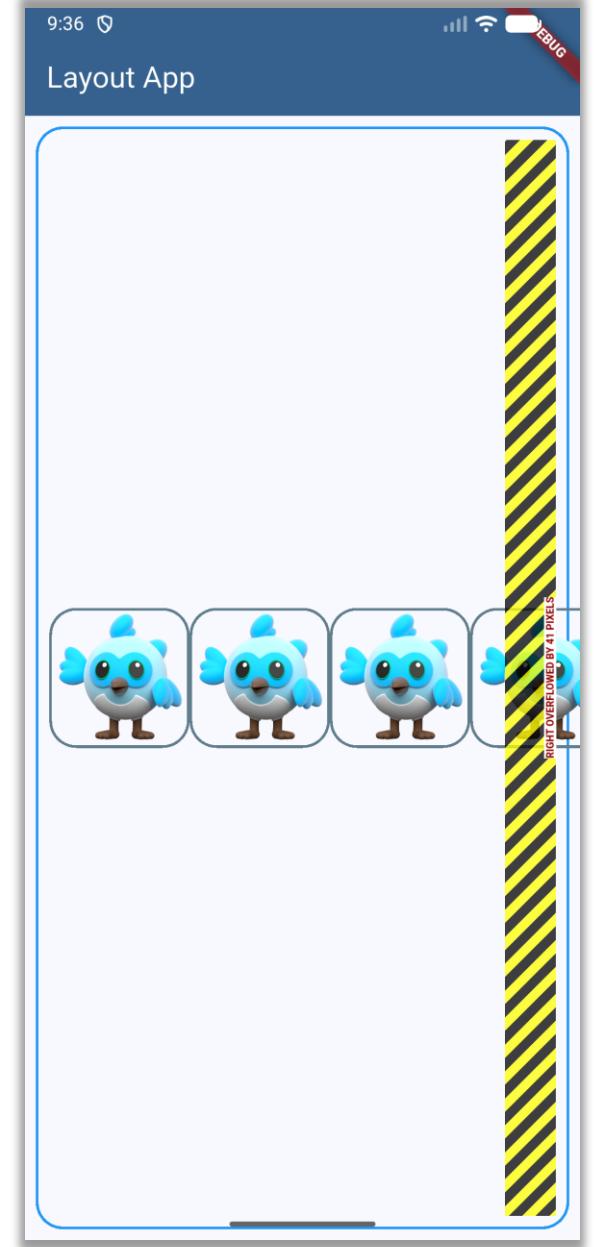
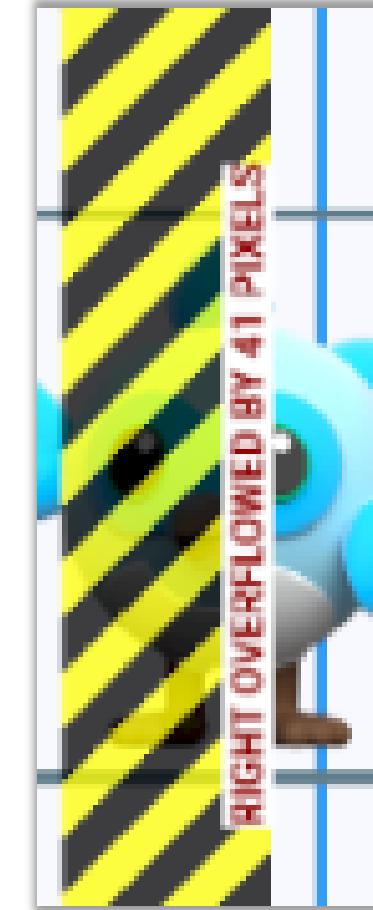
(Left, Top)  
(x, y)



# Screen Overflow

```
child: Row(  
    mainAxisAlignment: MainAxisAlignment.spaceEvenly,  
    crossAxisAlignment: CrossAxisAlignment.center,  
    children: [  
        BorderedImage(),  
        BorderedImage(),  
        BorderedImage(),  
        BorderedImage(),  
    ],  
, // Row
```

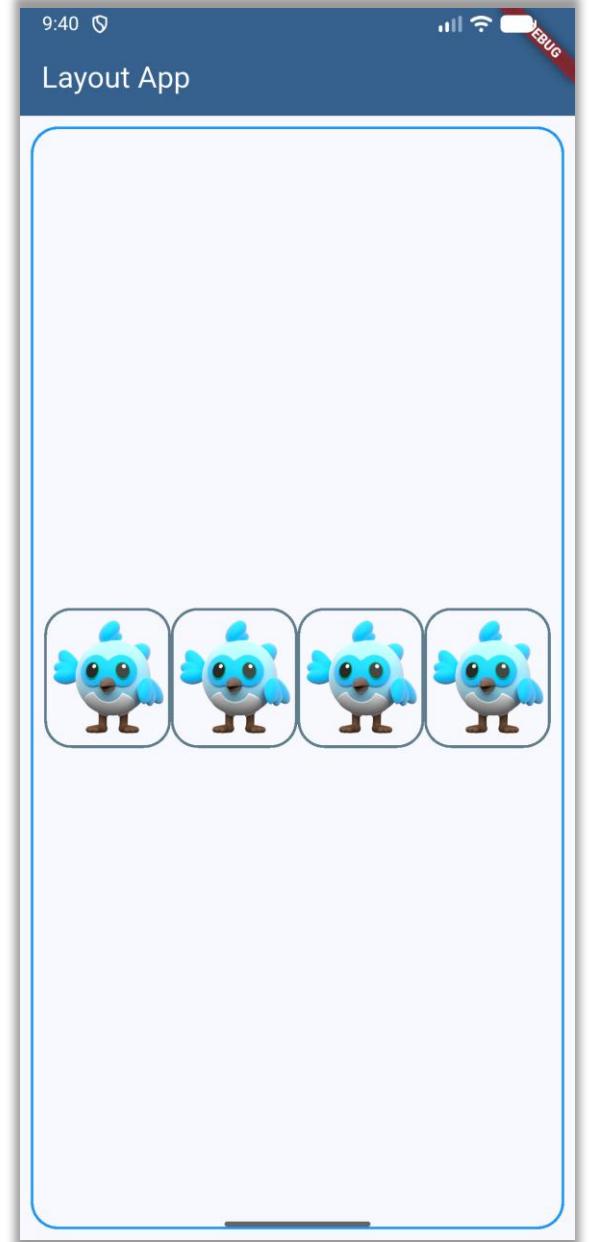
Two ways to handle this



# Expanded Widget

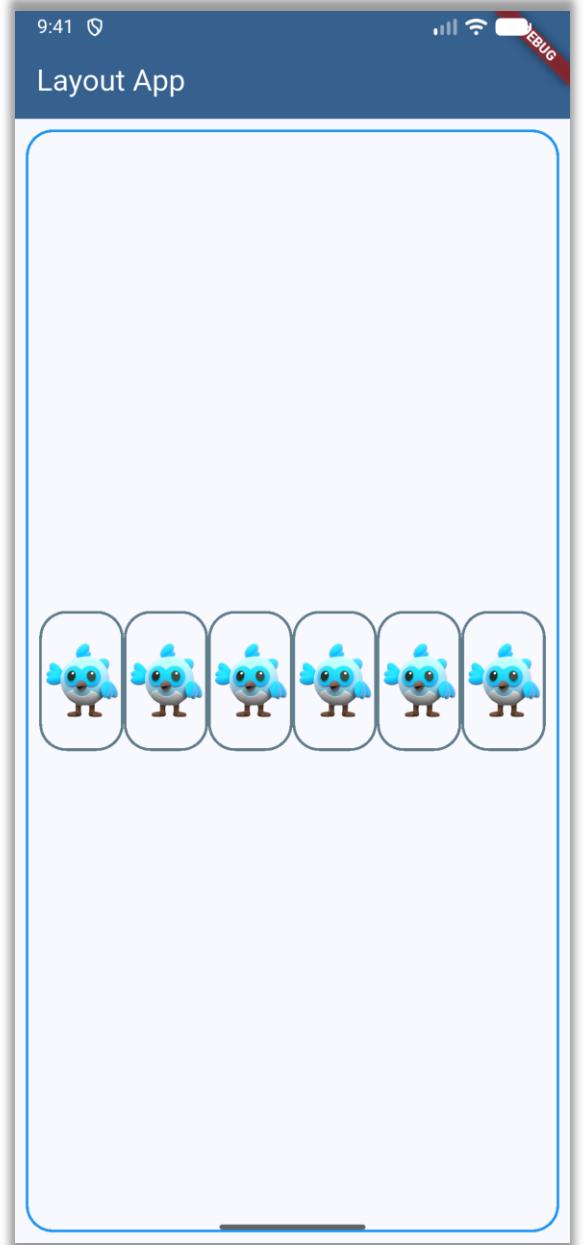
- Dictate how much space a widget should take up relative to its siblings

```
child: Row(  
    mainAxisAlignment: MainAxisAlignment.spaceEvenly,  
    crossAxisAlignment: CrossAxisAlignment.center,  
    children: [  
        Expanded(child: BorderedImage()),  
        Expanded(child: BorderedImage()),  
        Expanded(child: BorderedImage()),  
        Expanded(child: BorderedImage()),  
    ],  
) // Row
```



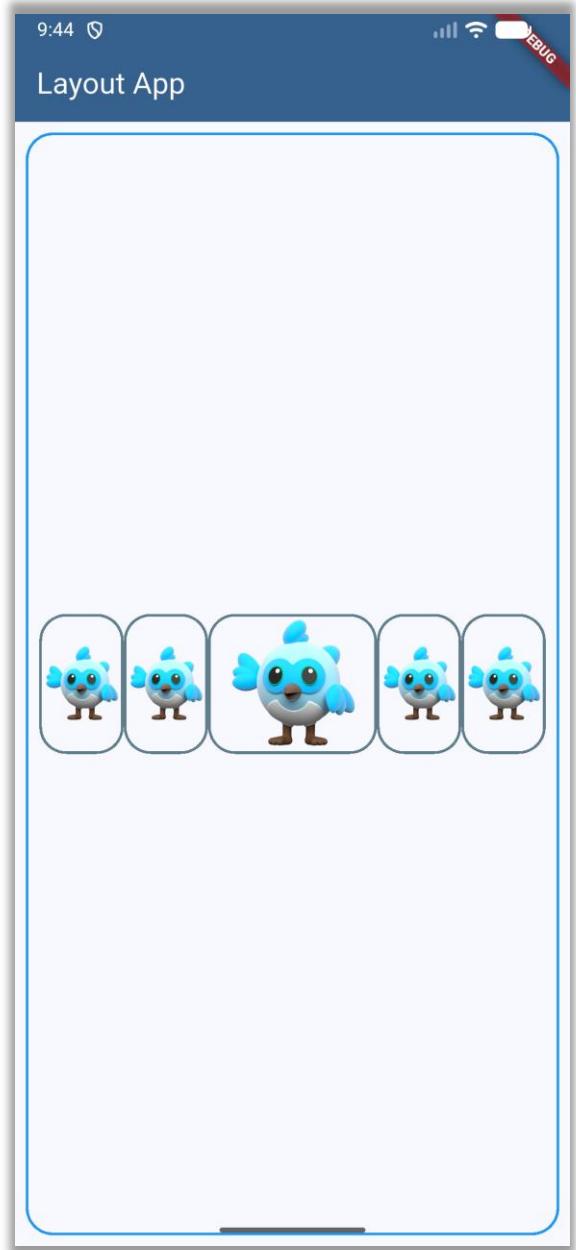
# Expanded Widget

```
child: Row(  
    mainAxisAlignment: MainAxisAlignment.spaceEvenly,  
    crossAxisAlignment: CrossAxisAlignment.center,  
    children: [  
        Expanded(child: BorderedImage()),  
        Expanded(child: BorderedImage()),  
        Expanded(child: BorderedImage()),  
        Expanded(child: BorderedImage()),  
        Expanded(child: BorderedImage()),  
        Expanded(child: BorderedImage()),  
    ],  
, // Row
```



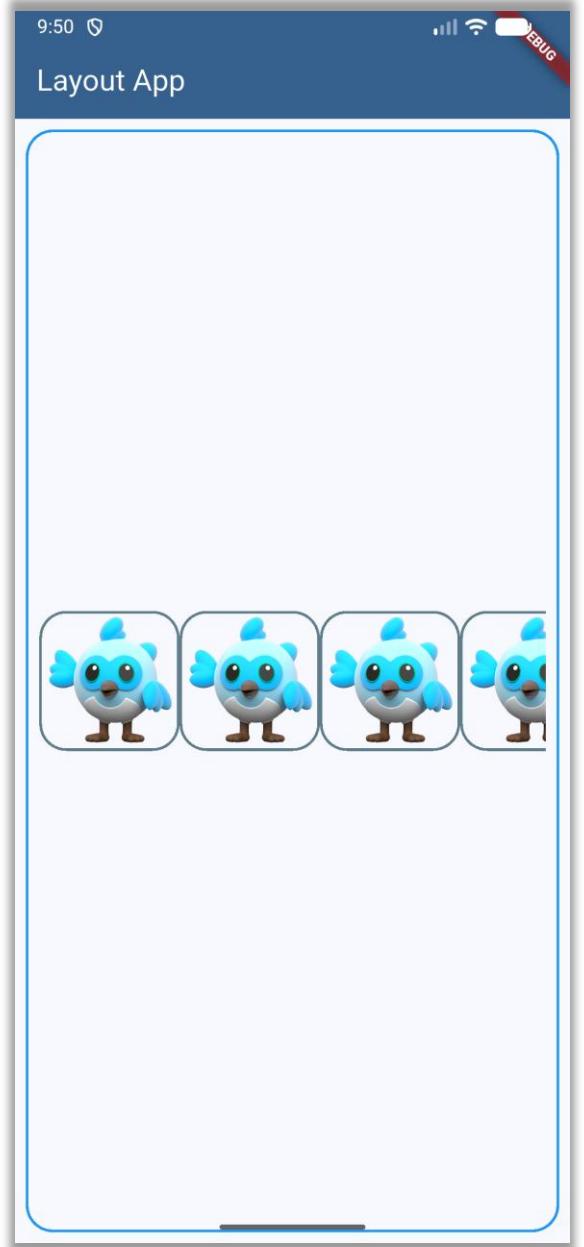
# Expanded Widget flex property

```
child: Row(  
    mainAxisAlignment: MainAxisAlignment.spaceEvenly,  
    crossAxisAlignment: CrossAxisAlignment.center,  
    children: [  
        Expanded(child: BorderedImage()),  
        Expanded(child: BorderedImage()),  
        Expanded(flex: 2, child: BorderedImage()),  
        Expanded(child: BorderedImage()),  
        Expanded(child: BorderedImage()),  
    ],  
, // Row
```



# Scrolling

```
child: SingleChildScrollView(  
    scrollDirection: Axis.horizontal,  
    child: Row(  
        mainAxisAlignment: MainAxisAlignment.spaceEvenly,  
        crossAxisAlignment: CrossAxisAlignment.center,  
        children: [  
            BorderedImage(),  
            BorderedImage(),  
            BorderedImage(),  
            BorderedImage(),  
            BorderedImage(),  
        ],  
    ), // Row  
, // SingleChildScrollView
```



# References

- <https://docs.flutter.dev/get-started/fundamentals/widgets>
- <https://m3.material.io/components/app-bars/overview>
- <https://m3.material.io/components/navigation-bar/overview>
- <https://m3.material.io/components/navigation-drawer/overview>
- <https://m3.material.io/components/bottom-sheets/overview>
- <https://docs.flutter.dev/get-started/fundamentals/layout>
- <https://docs.flutter.dev/ui/widgets/layout>
- <https://github.com/mahdinazmi/Flutter-Basics>