UNIVERSITY OF PADOVA
DEPARTMENT OF INFORMATION ENGINEERING

Biomedical Wearable Technologies
for Healthcare and Wellbeing

# Hello, Flutter!

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DEPARTMENT OF
INFORMATION
ENGINEERING
UNIVERSITY OF PADOVA

# Outline

- **Flutter**
- Creating a new project
- App dissection
- Expanding our first app

- Homework & Resources

# Flutter

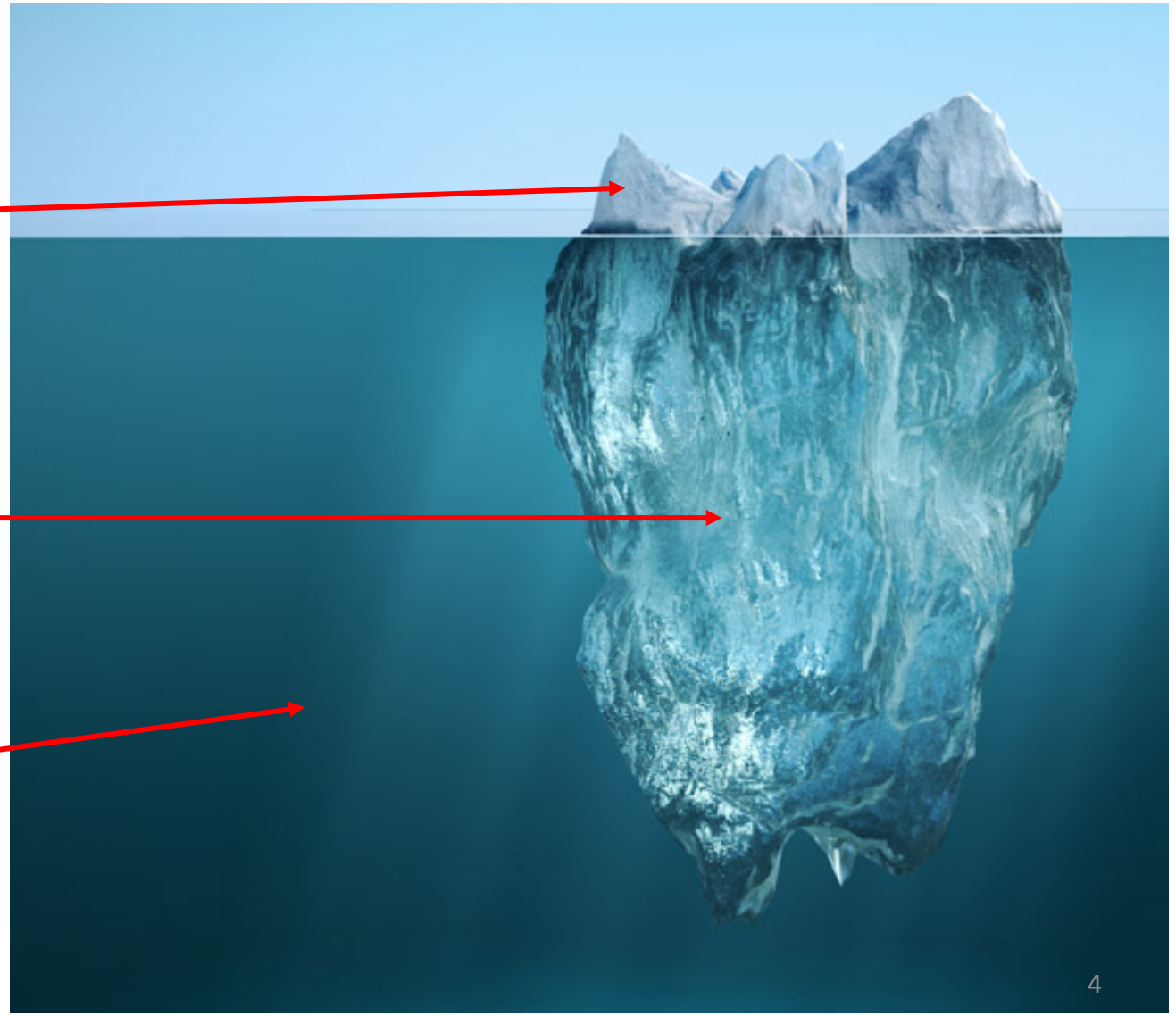
- What is Flutter?
  - Simply a declarative framework for Dart

- Why this choice?
  - State-of-the-art and Google-maintained
  - Single codebase for iOS and Android (and Mac, Windows, Web)
  - Relatively easy to learn
  - Lots of examples
  - Fastly growing job market

- Today we will create and study our first Flutter app

# Before starting…

- What you'll see in these labs about Flutter capabilities
- Actual things that you will probably use
- Flutter possibilities



# Outline

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# Hello, Flutter!

- In this lesson, we will run and analyse our first Flutter app

- First, setup VS Code to work with Flutter **(this should have already been done)**
  1. Start VS Code.
  2. Invoke **View > Command Palette…**.
  3. Type “install”, and select **Extensions: Install Extensions**.
  4. Type “flutter” in the extensions search field, select **Flutter** in the list, and click **Install**. This also installs the required Dart plugin.

- Then, create the app
  1. Invoke **View > Command Palette**.
  2. Type “flutter”, and select the **Flutter: New Project**.
  3. Select **Application**
  4. Select the parent directory that will contain the app
  5. Enter a project name, such as ”my_first_app”, and press **Enter**.
  6. Wait for project creation to complete and the main.dart file to appear.

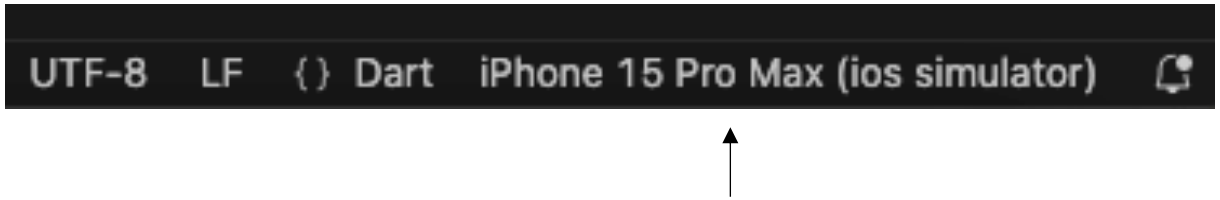
# Hello, Flutter!

- Replace all the code of main.dart with

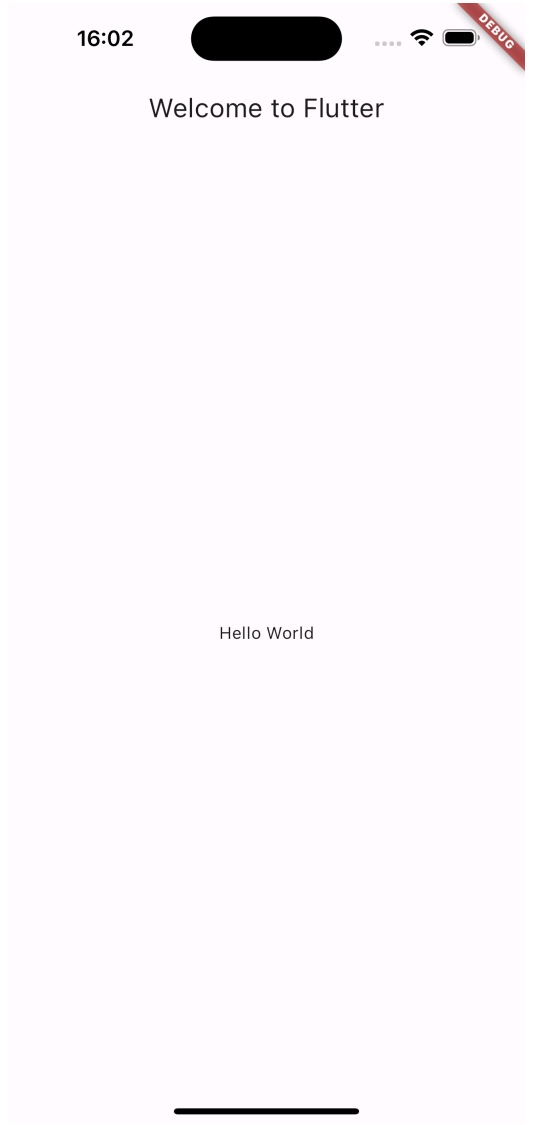
```
import 'package:flutter/material.dart';
void main() {
  runApp(MyApp());
}//main
class MyApp extends StatelessWidget {
  MyApp({Key? key}) : super(key: key);

  @override
  Widget build(BuildContext context) {
    return MaterialApp(
      title: 'Welcome to Flutter’,
      home: Scaffold(
      appBar: AppBar(title: Text('Welcome to Flutter'),),
      body: Center(child: Text('Hello World'),),),
    );
  }//build
}//MyApp
```

# Hello, Flutter!

- Finally, run the app!
  1. Locate the VS Code status bar (the bar at the bottom of the window):



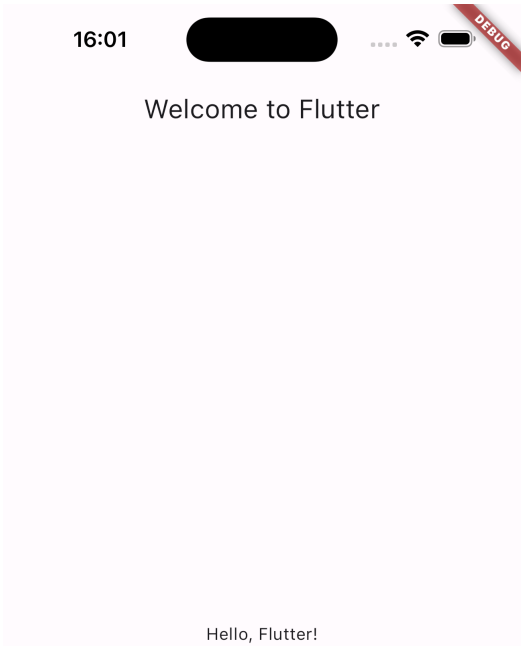

  2. Select a mobile device from the **Device Selector** area
  3. Invoke **Run > Start Debugging** or press **F5**
  4. Wait for the app to launch — progress is printed in the **Debug Console** view.
  5. After the app build completes, you'll see the starter app on your device.



# A great feature: Hot reload

- Dart offers a fast development cycle with *Stateful Hot Reload*, the ability to reload the code of a live running app without restarting or losing app state. Make a change to app source, tell your IDE or command-line tool that you want to hot reload, and see the change in your simulator, emulator, or device.

- Try that!
  1. Open lib/main.dart.
  2. Change the string
     `'Hello World'`
     with
     `'Hello, Flutter!'`
  3. Save your changes: invoke **Save All**, or click **Hot Reload**
  4. You'll see the updated string in the running app almost immediately.



# Outline

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# Let’s dissect the app

- Let’s understand what we have done.

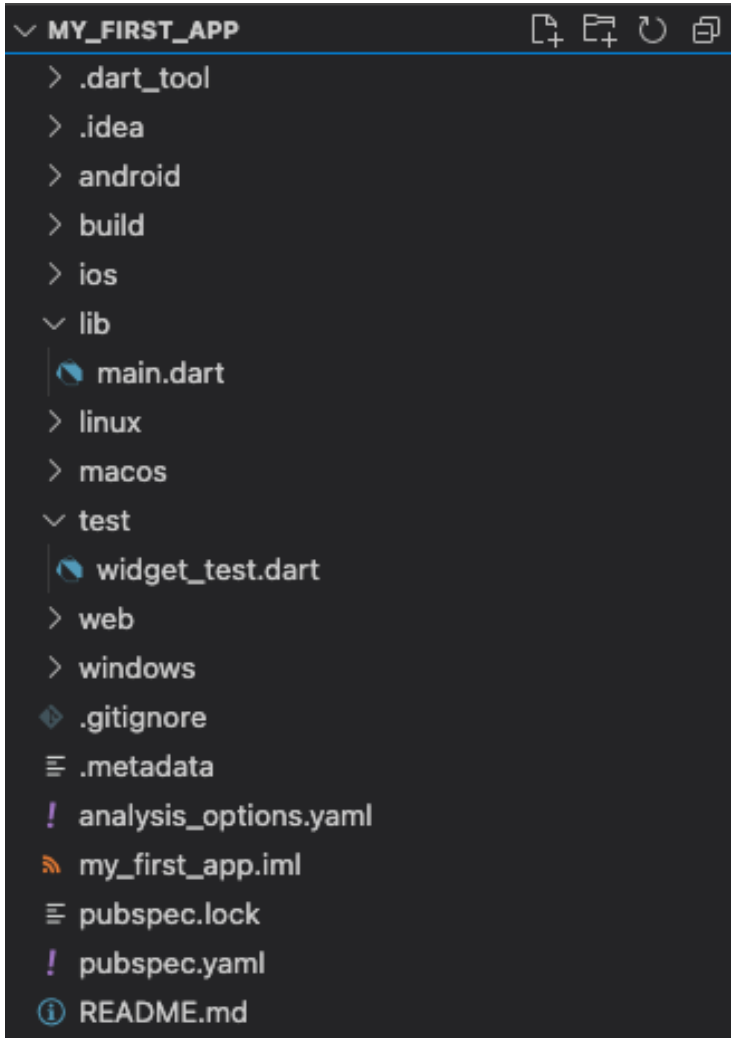
# Let's dissect the app – Project folder

- First, what's inside the project folder?

- Important things
  - **lib folder**: it contains the app source code
  - **main.dart file**: the entry point for the compiler
  - **pubspec.yaml file**: it specifies high level app features as well as listing which third party libraries our app needs and uses
  - **README.md file**: a markdown file describing the app

- (Less) Important things
  - **android/ios/linux/macos/windows/web folders**: where native specific code can be defined if needed
  - **test folder**: where to put code for running automatic testers

- (Even less) Important things
  - All other folders and files are very use case specific and probably you will never use those in this course. If you are curious…



# Let's dissect the app – main.dart

- Let's understand the main.dart file.

```
import 'package:flutter/material.dart';
void main() {
  runApp(MyApp());
}//main
class MyApp extends StatelessWidget {
  MyApp({Key? key}) : super(key: key);

  @override
  Widget build(BuildContext context) {
    return MaterialApp(
      title: 'Welcome to Flutter',
      home: Scaffold(
      appBar: AppBar(title: Text('Welcome to Flutter'),),
      body: Center(child: Text('Hello World'),),),
    );
  }//build
}//MyApp
```

To run an app using the Flutter framework we can use the **`runApp`** method which takes a **`Widget`** object as an input.

**What's a `Widget`?**

# Everything is a Widget

- In Flutter, almost everything is (inherits from) a Widget!
- A Widget is a building block for your user interface (UI). Using widgets is like combining Legos.
- More technically, a Widget is a sort of blueprint for displaying your app state.
- Widgets can be thought as a function of UI. Given a state, the build() method (that every custom Widget must override and implement) constructs the widget UI:


# Let's dissect the app – main.dart

- In **bold** the Widgets of our app

```
import 'package:flutter/material.dart';
void main() {
  runApp(MyApp());
}//main
class MyApp extends StatelessWidget {
  MyApp({Key? key}) : super(key: key);

  @override
  Widget build(BuildContext context) {
    return MaterialApp(
      title: 'Welcome to Flutter',
      home: Scaffold(
      appBar: AppBar(title: Text('Welcome to Flutter'),),
      body: Center(child: Text('Hello World'),),),
    );
  }//build
}//MyApp
```

Key method for building the Widget that must be implemented

**But how Widgets are combined together?**

# The Widget Tree

- Widgets are combined together using a **tree structure**

```
import 'package:flutter/material.dart';
void main() {
  runApp(MyApp());
}//main
class MyApp extends StatelessWidget {
  MyApp({Key? key}) : super(key: key);

  @override
  Widget build(BuildContext context) {
    return MaterialApp(
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      home: Scaffold(
      appBar: AppBar(title: Text('Welcome to Flutter'),),
      body: Center(child: Text('Hello World'),),),
    );
  }//build
}//MyApp
```
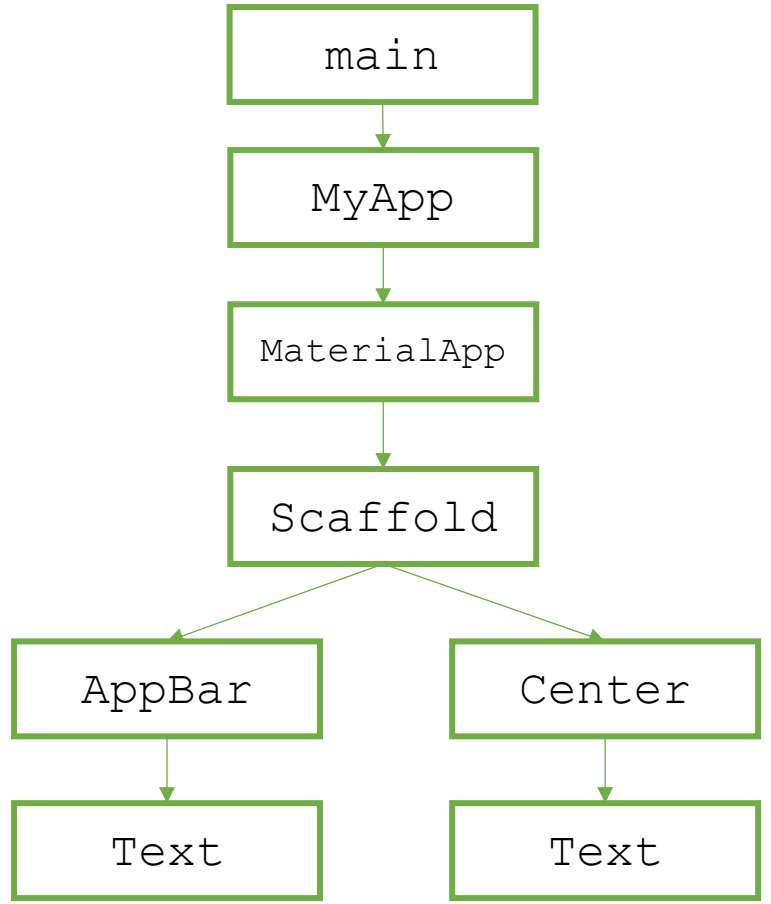



# State and widgets

- In bold the Widgets of our app

```
import 'package:flutter/material.dart';
void main() {
  runApp(MyApp());
}//main
class MyApp extends StatelessWidget {
  MyApp({Key? key}) : super(key: key);

  @override
  Widget build(BuildContext context) {
    return MaterialApp(
      title: 'Welcome to Flutter',
      home: Scaffold(
      appBar: AppBar(title: Text('Welcome to Flutter'),),
      body: Center(child: Text('Hello World'),),),
    );
  }//build
}//MyApp
```

MyApp is not just a Widget, it is a `StatelessWidget`

# Stateless vs. Stateful widgets

- **`StatelessWidget`**s are Widgets that always build the same way given a particular configuration and ambient state. So, they never re-build while they are displayed to the user (their lifetime).

- **`StatefulWidget`**s for widgets that can build differently several times over their lifetime.

- You can think about StatelessWidget as a sort of constant and StatefulWidget as a variable.

# Let's dissect the app – pubspec.yaml

- pubspec.yaml contains high-level instructions for the development environment and information on the app

```
name: my_first_app
description: A new Flutter project.
publish_to: 'none'
version: 1.0.0+1

environment:
  sdk: ">=3.2.4 <4.0.0"

dependencies:
  flutter:
    sdk: flutter

  cupertino_icons: ^1.0.2

dev_dependencies:
  flutter_test:
    sdk: flutter
  flutter_lints: ^2.0.0

flutter:
  uses-material-design: true
```

my_first_app information (name, description, version, …)

Flutter sdk version to be used

App dependencies: what the app needs in order to work: other packages? Other libraries? Put them here.

App dependencies while developing the app

Information for the Flutter environment such as where to find assets.



Full example in lab_04-hello_flutter/my_first_app/

# Outline

- Flutter
- Creating a new project
- App dissection
- **Expanding our first app**

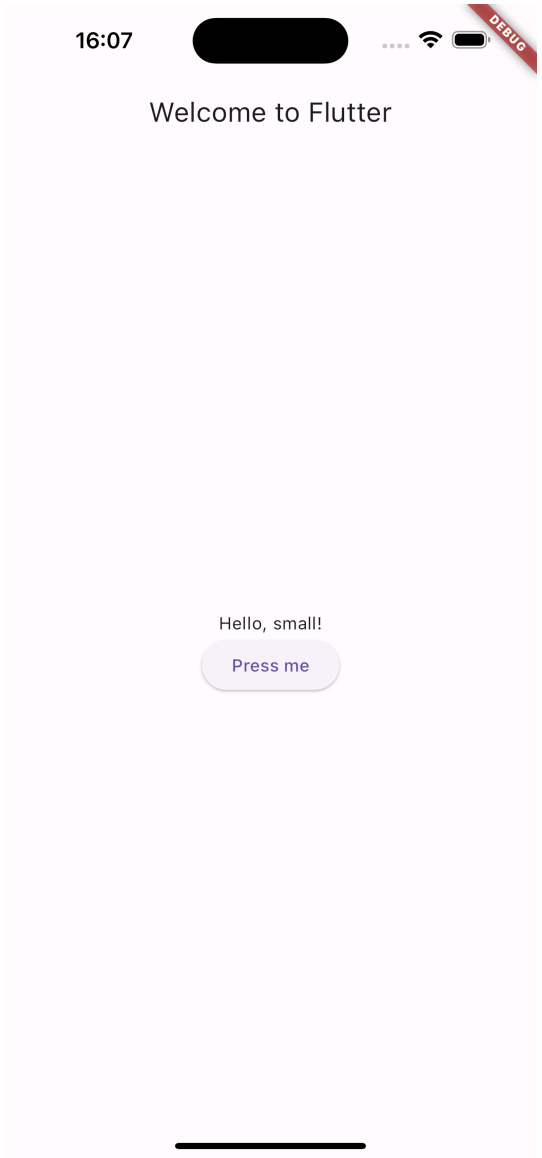
- Homework & Resources

# My first app with steroids

- Let's play with my_first_app and let's expand it
- We will learn how to:
  - Install an external package and add it as a dependency
  - Use the external package inside our app
  - StatefulWidgets 101
  - How to modify the UI

# My first app with steroids

- **Aim**: The result will be a very simple app that, each time a button is tapped, a new random ”Hello” message is shown to the user.



# My first app with steroids

- Roadmap

1. Understand what to use to generate a random word
2. Generate a random word and check that everything is working
3. Display the word in the “Hello” message
4. Modify the UI to generate a new message each time a button is tapped

# Solving point 1

- We do not want to code a random English word generator!
- On the Internet we can find a lot of already made code and ready-to-use packages that can fit your needs
- A place that we will visit often during this course is pub.dev:

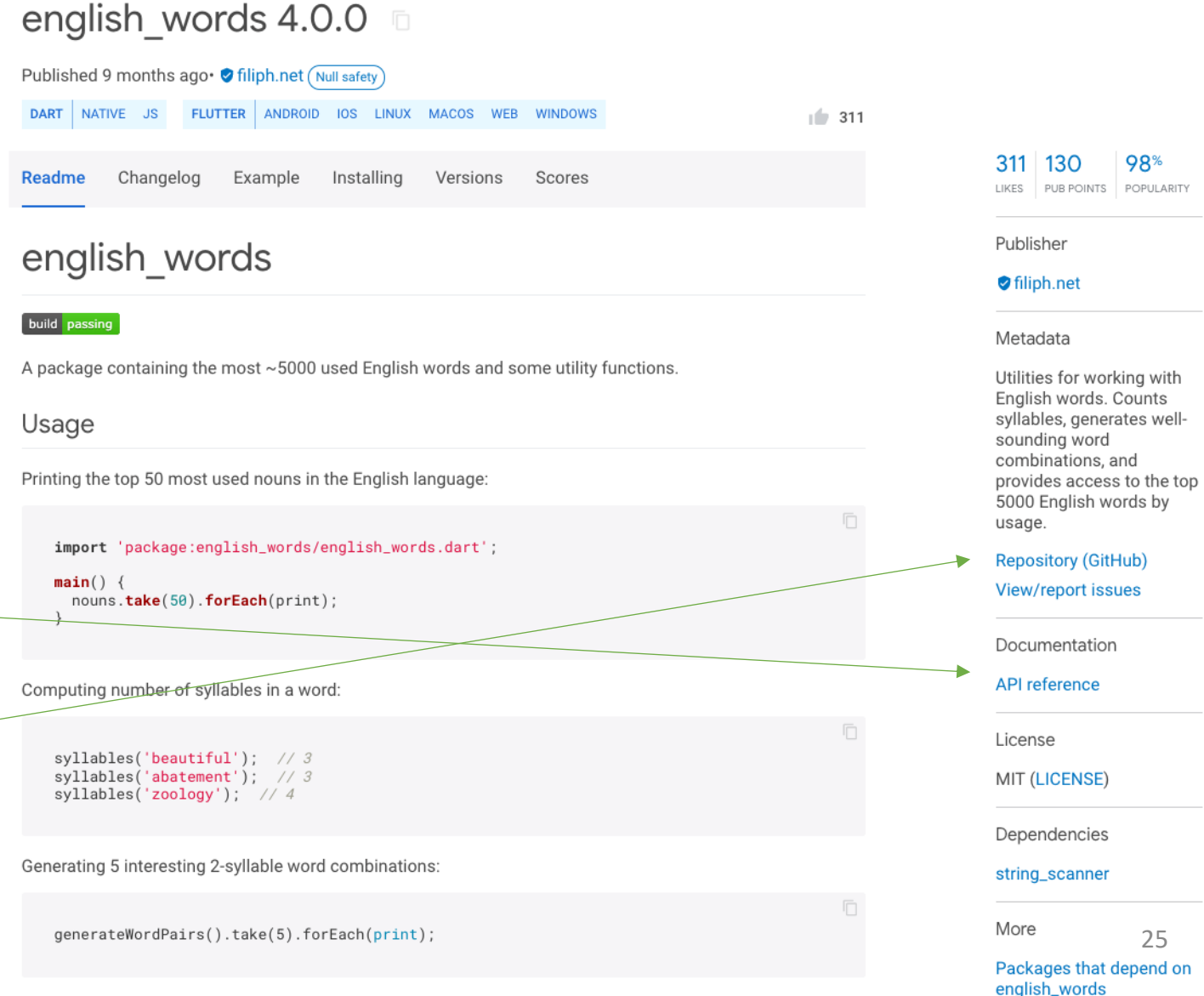
# This is the package I was looking for

- After some research, it seems like the **english_words package** can solve our needs

- It can generate words and words pairs!

**How to use it? Docs!**

**Code is available too!**



english_words 4.0.0

Published 9 months ago• filiph.net Null safety

DART | NATIVE | JS | FLUTTER | ANDROID | IOS | LINUX | MACOS | WEB | WINDOWS

311

Readme | Changelog | Example | Installing | Versions | Scores

## english_words

build passing

A package containing the most ~5000 used English words and some utility functions.

### Usage

Printing the top 50 most used nouns in the English language:

```
import 'package:english_words/english_words.dart';

main() {
  nouns.take(50).forEach(print);
}
```

Computing number of syllables in a word:

```
syllables('beautiful');  // 3
syllables('abatement');  // 3
syllables('zoology');  // 4
```

Generating 5 interesting 2-syllable word combinations:

```
generateWordPairs().take(5).forEach(print);
```

311 LIKES | 130 PUB POINTS | 98% POPULARITY

Publisher

filiph.net

Metadata

Utilities for working with English words. Counts syllables, generates well-sounding word combinations, and provides access to the top 5000 English words by usage.

Repository (GitHub)

View/report issues

Documentation

API reference

License

MIT (LICENSE)

Dependencies

string_scanner

More

Packages that depend on english_words

# Including english_words in the app

- Installing the english_words package in our app is very easy.
- By definition, it is a dependency right?
- So, let's add it under the dependency list of our app into pubspec.yaml
- After adding it, save pubspec.yaml and you will see VSCode running **`flutter pub get`** for you.
- Done!

```
...

dependencies:
  flutter:
    sdk: flutter

  cupertino_icons: ^1.0.2

  english_words: ^4.0.0

...
```

# My first app with steroids

- Roadmap

1. **Understand what to use to generate a random word**

2. Generate a random word and check that everything is working
3. Display the word in the “Hello” message
4. Modify the UI to generate a new message each time a button is tapped

# Generating a random word

- Let's add some line of code to main.dart to generate a word using the english_words package

- Modify the build method by adding

```
final word = WordPair.random().first;
```

before the return statement and run the app.

- Nothing it's happening. How to see if we are generating a random word?

- We can use the logger and the debug console!

# Logging things

- Simply try to print the word value as a normal Dart program:

```
final word = WordPair.random().first;
print(word);
```

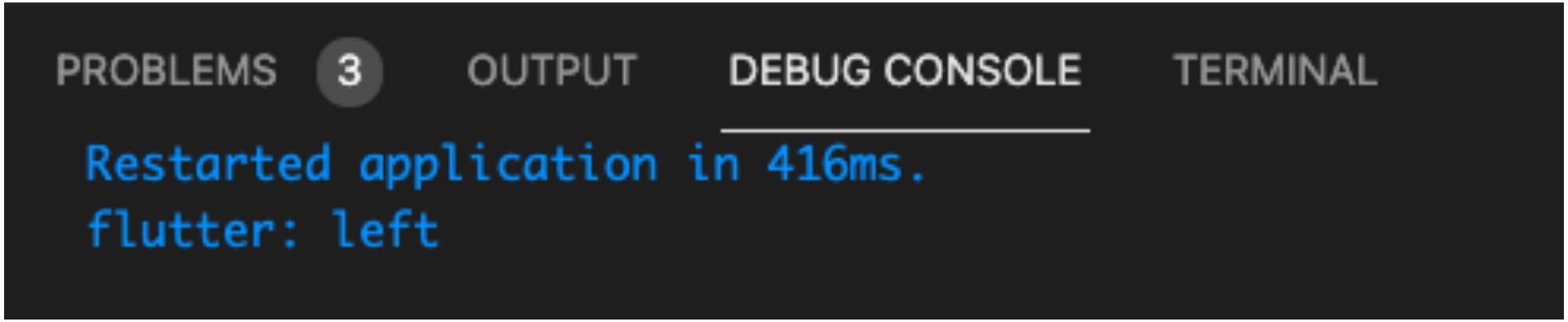
- If you run the application now you will see something like this in the **Debug Console** of VS Code:

```
Launching lib/main.dart on iPhone 15 Pro Max in debug mode...
Xcode build done.                                           7.4s
[ERROR:flutter/shell/platform/darwin/graphics/FlutterDarwinContextMetalImpeller.mm(42)] Using the
Impeller rendering backend.
Connecting to VM Service at ws://127.0.0.1:57673/3DHwaPh0oRM=/ws
flutter: kid
```

# Logging things

- Every time you reload/restart the app


- …you will see a different word



# My first app with steroids

- Roadmap

1. **Understand what to use to generate a random word** 
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# Change the Hello message

- You should be able to solve this point by yourself now
- Simply, using string interpolation, change

`'Hello, Flutter!'` to `'Hello, $word!'`

- and save to reload the app and see the changes.

# My first app with steroids

- Roadmap

1. **Understand what to use to generate a random word** 
2. **Generate a random word and check that everything is working** 
3. **Display the word in the “Hello” message** 
4. Modify the UI to generate a new message each time a button is tapped

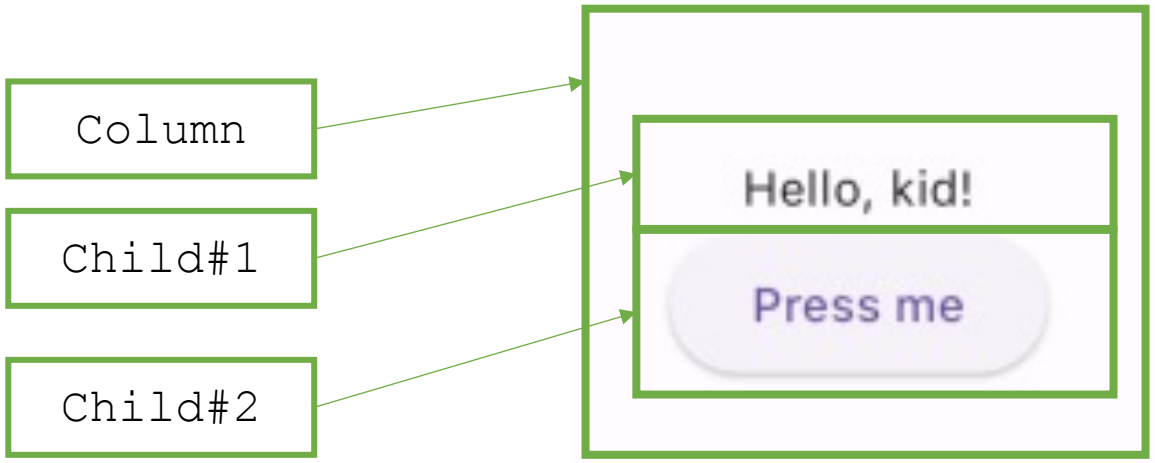
# Changing the UI

- Let's start by simply changing the UI
- We need to obtain something like
- Problems:
  1. How to add a button
  2. How to put it there

# The Column Widget

- We can use the Column widget.
- It has a list of children (not like Text or Center or Scaffold)
- Children are lined up to a column from top to the bottom

```
Column(
  children: [
    Child#1,
    Child#2,
  ],
);
```



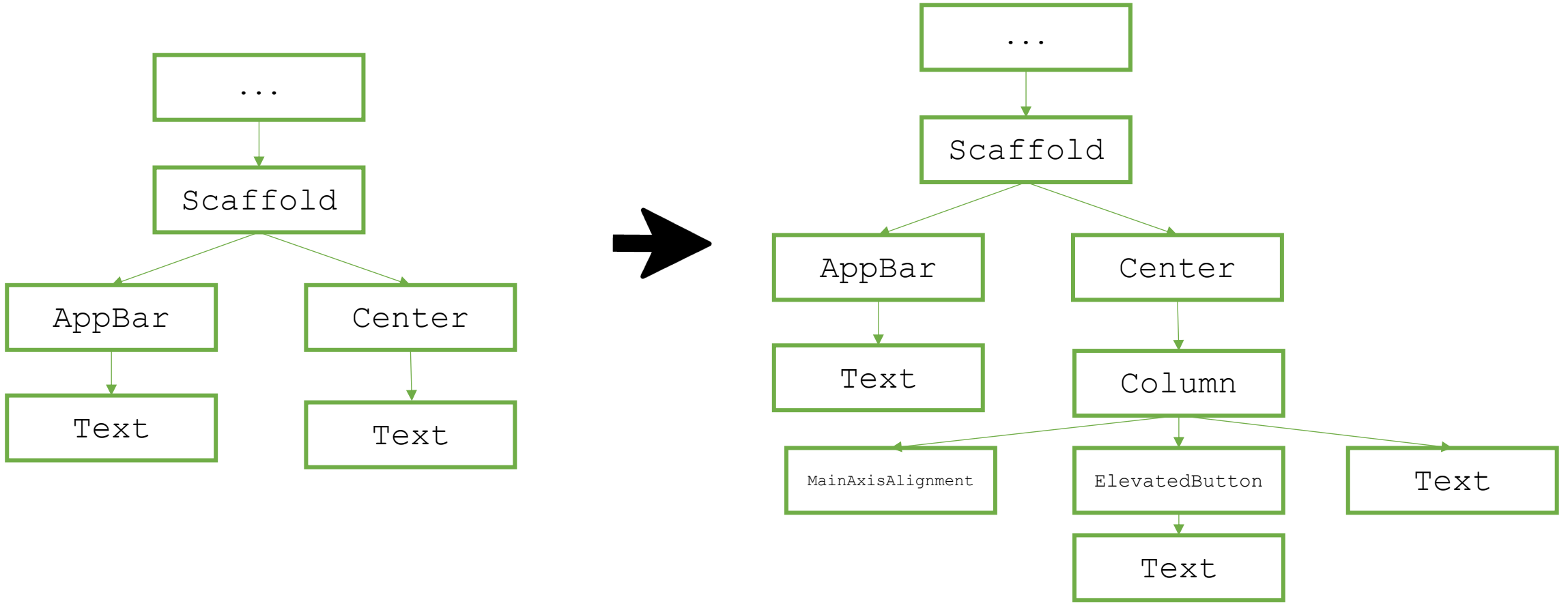
# Implement the new UI

- Change the build method of MyApp to

```
Widget build(BuildContext context) {
  final word = WordPair.random().first;
  print(word);
  return MaterialApp(
    title: 'Welcome to Flutter’,
    home: Scaffold(
      appBar: AppBar(title: Text('Welcome to Flutter'),),
      body: Center(
        child: Column(
          mainAxisAlignment: MainAxisAlignment.center,
          children: [
            Text('Hello, $word!’),
            ElevatedButton(onPressed: (){}, child: Text('Press me')),
          ],
        ),),),
  );
}//build
```

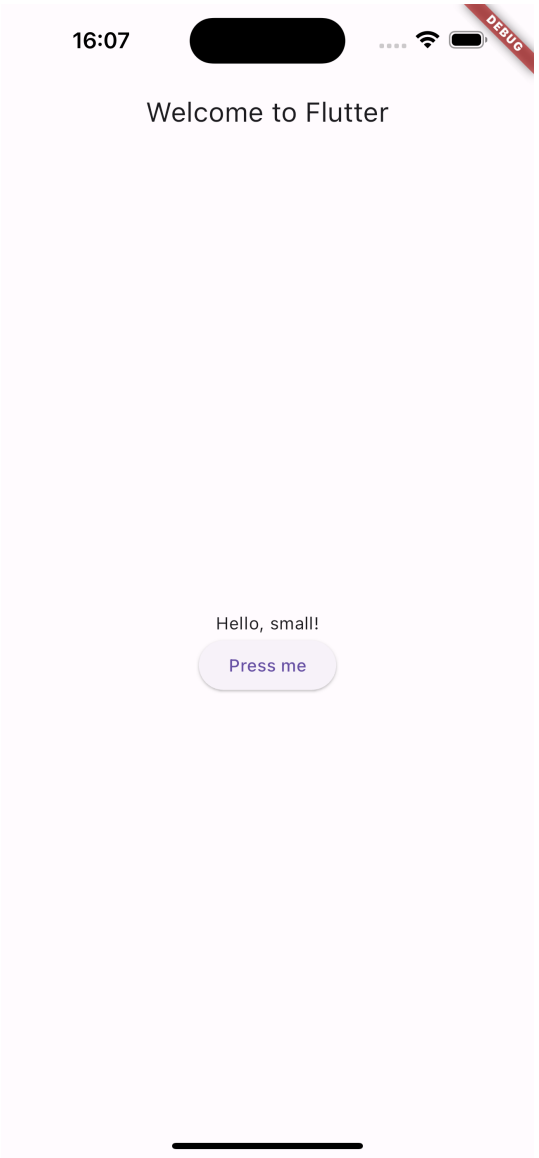
# Different UI, different tree

- How the widget tree changed?



# Changing the UI

- (New) Problem: How to change the message when we press the button?
- In other words: how to change the **app state** without reloading or restarting everything
- We need a **`StatefulWidget`**



# StatefulWidget

- As we mentioned before, stateful widgets maintain state that might change during the lifetime of the widget.

- Implementing a stateful widget requires at least two classes:

1. A **`StatefulWidget` class** that creates an instance of the `Widget` itself
2. A **`State` class:** a class that manages the state of the **`StatefulWidget`**

# The boilerplate code of a StatefulWidget

```
class RandomHello extends StatefulWidget{
  RandomHello({Key? key}) : super(key: key);

  @override
  _RandomHelloState createState() => _RandomHelloState();
}//RandomHello

class _RandomHelloState extends State<RandomHello>{

  @override
  Widget build(BuildContext buildContext){
    //return some widget
  }//build

}//_RandomHelloState
```

# Refactoring the UI - RandomHello

- Let's copy some code into the build method new Widget

```
...
class _RandomHelloState extends State<RandomHello>{

  @override
  Widget build(BuildContext buildContext){
    final word = WordPair.random().first;
    return Column(
      mainAxisAlignment: MainAxisAlignment.center,
      children: [
        Text('Hello, $word!'),
        ElevatedButton(onPressed: (){}, child: Text('Press
me')),
      ],
    );
  }//build

}//_RandomHelloState
```

# Refactoring the UI - MyApp

- Now let's refactor the MyApp code

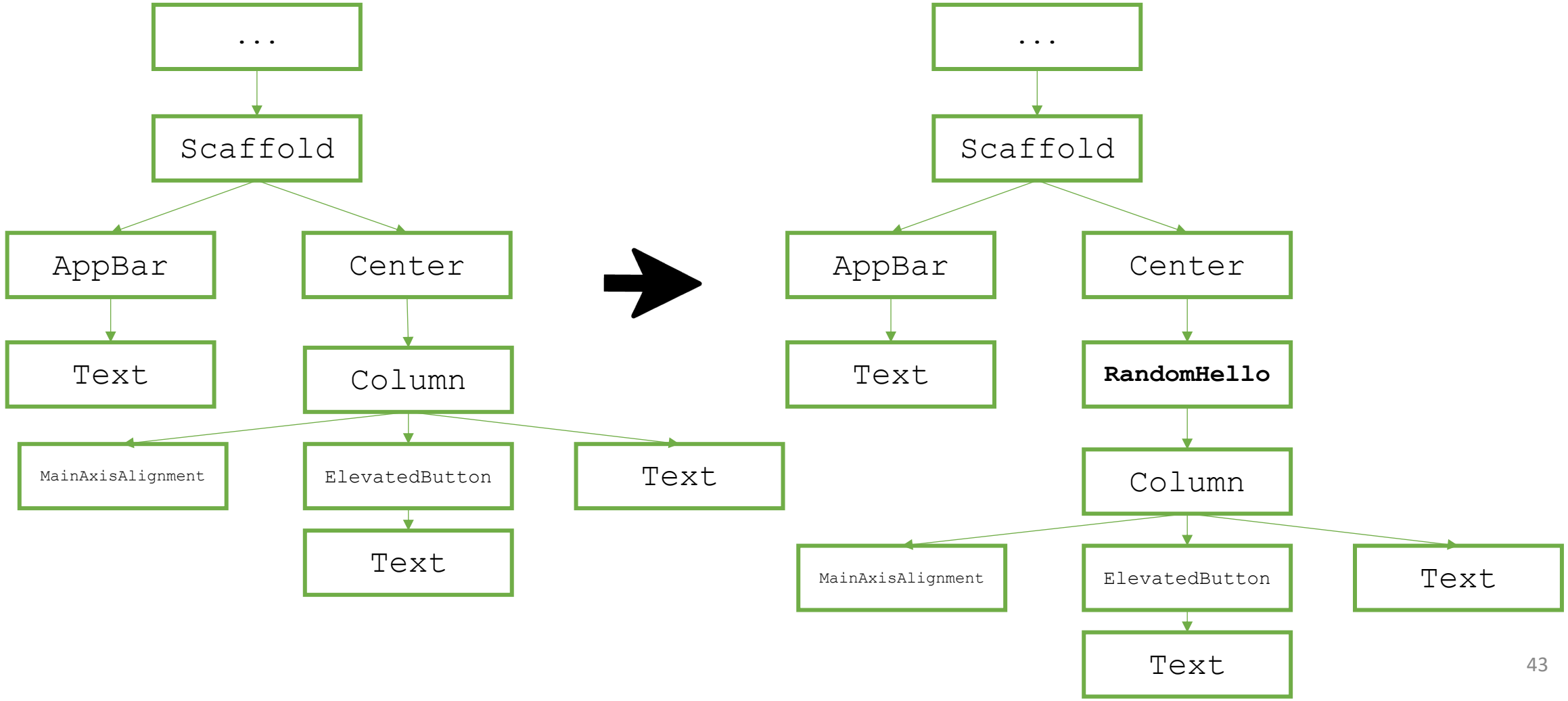
```
class MyApp extends StatelessWidget {
  MyApp({Key? key}) : super(key: key);

  @override
  Widget build(BuildContext context) {
    return MaterialApp(
      title: 'Welcome to Flutter',
      home: Scaffold(
        appBar: AppBar(title: Text('Welcome to Flutter'),),
        body: Center(child: RandomHello(),),
      ),
    );
  }//build

}//MyApp
```

# Same UI, different tree

- The UI should look like the same as before, but we have a new widget tree



# void initState(){}

- Let's do some changes to RandomHello to make it more **stateful**

```
class _RandomHelloState extends State<RandomHello>{

  String? _word;

  @override
  void initState() {
    _word = WordPair.random().first;
    super.initState();
  }//initState

...
```

`_word` will represent the state of the Widget

`initState` is a special method that is called the first time the Widget is created. It is used (as its name suggest) to initialize the state of the Widget itself.

# setState(){}

- We are ready to implement the function to provide to onPressed

```
...
@override
Widget build(BuildContext buildContext){
  return Column(
    mainAxisAlignment: MainAxisAlignment.center,
      children: [
        Text('Hello, $_word!'),
        ElevatedButton(onPressed: _changeRandomWord, child: Text('Press
me')),
      ],);
}//build

void _changeRandomWord(){
  setState(() {
    _word = WordPair.random().first;
  });
}//_changeRandomWord
...
```

`setState` is a special method that requires a callback function as input. setState notifies the Flutter framework that the state might be changed causing to delete and rebuild the widget itself.

# My first app with steroids

- Roadmap

1. **Understand what to use to generate a random word** 
2. **Generate a random word and check that everything is working** 
3. **Display the word in the “Hello” message** 
4. **Modify the UI to generate a new message each time a button is tapped** 



Full example in lab_04-hello_flutter/my_first_app_with_steroids/

# Outline

- Flutter
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- Expanding our first app

- **Homework & Resources**

# Homework

- Play with our first example
- Get familiar with the structure of a Flutter project and how to install new packages using pubspec.yaml
- Get familiar with the concept of Widget
- To know what to do to create a StatelessWidget and a StatefulWidget
- Understanding the Flutter flow

# Resources

- Code repository of today's lesson and exercises solution
  - https://github.com/gcappon/bwthw/tree/master/lab_04-hello_flutter
- Introduction to Widgets
  - https://docs.flutter.dev/development/ui/widgets-intro
- Write your first Flutter app, part 1 codelab
  - https://docs.flutter.dev/get-started/codelab
- DevTools
  - https://docs.flutter.dev/development/tools/devtools/overview