



Flutter



# Flutter

## Exploring Flutter

### A powerful Tool for Cross-Platform App Development



Franklin Developer Lunch & Learn

Meetup – Franklin, TN, USA

By Richard Hoehn – June 2024

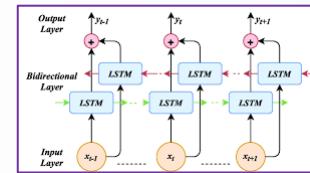
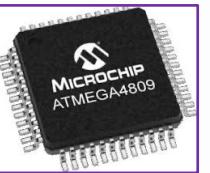
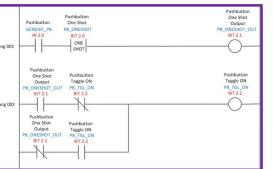


Franklin Developer Lunch & Learn – Richard Hoehn

6/11/24 - Slide 1



Flutter



## About Me

Living in Franklin, TN  
since 98

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Grew up in Switzerland  
Zurich Area

- 

Machinist by Trade  
CNC Programmer

- 

PLC – Ladder Logic

- ▼

Embedded ARM & AVR

- ▼

Web Development

- ▼

Application Backends

## Academics

PhD Student MTSU  
Computational Data Science

- 

### Focused Research

NLP Tasks – Emotions using  
Transformers

- 

Forecasting using LSTM(bi)

- 

Inventory Location Positioning

## Work

### Hoehn Innovations

Technology Consulting Shop

Prior:

Co-Founder / CTO Logistics  
Software +7yrs

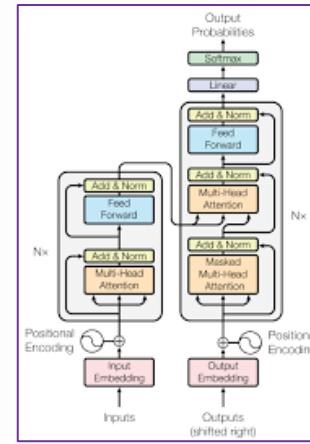
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Checkpoint Systems

New Product Development

- 

Griffin Technology  
iPhone Accessories





# Introduction & Agenda

## Introduction – Why I like Flutter...

- A cross-platform UI development Platform | Framework | SDK – **Code once!**
- Language **Dart** that is easy to use and Declarative in nature, but still strongly typed
- Easy to use Tool-Chain and TDD
- *and Finally* Open-Source with a large community supporting module development

## Agenda ~ 40min

- What is Flutter, the Architecture, and the SDK Setup
- Building an App, Widgets (*both Stateless and Stateful*), and the use of State Mgmt.
- Firebase and how Google backend support enabled quick development
- *and finally*, Review of Unique Features, Demo, and Conclusions





Flutter

# What is Flutter?

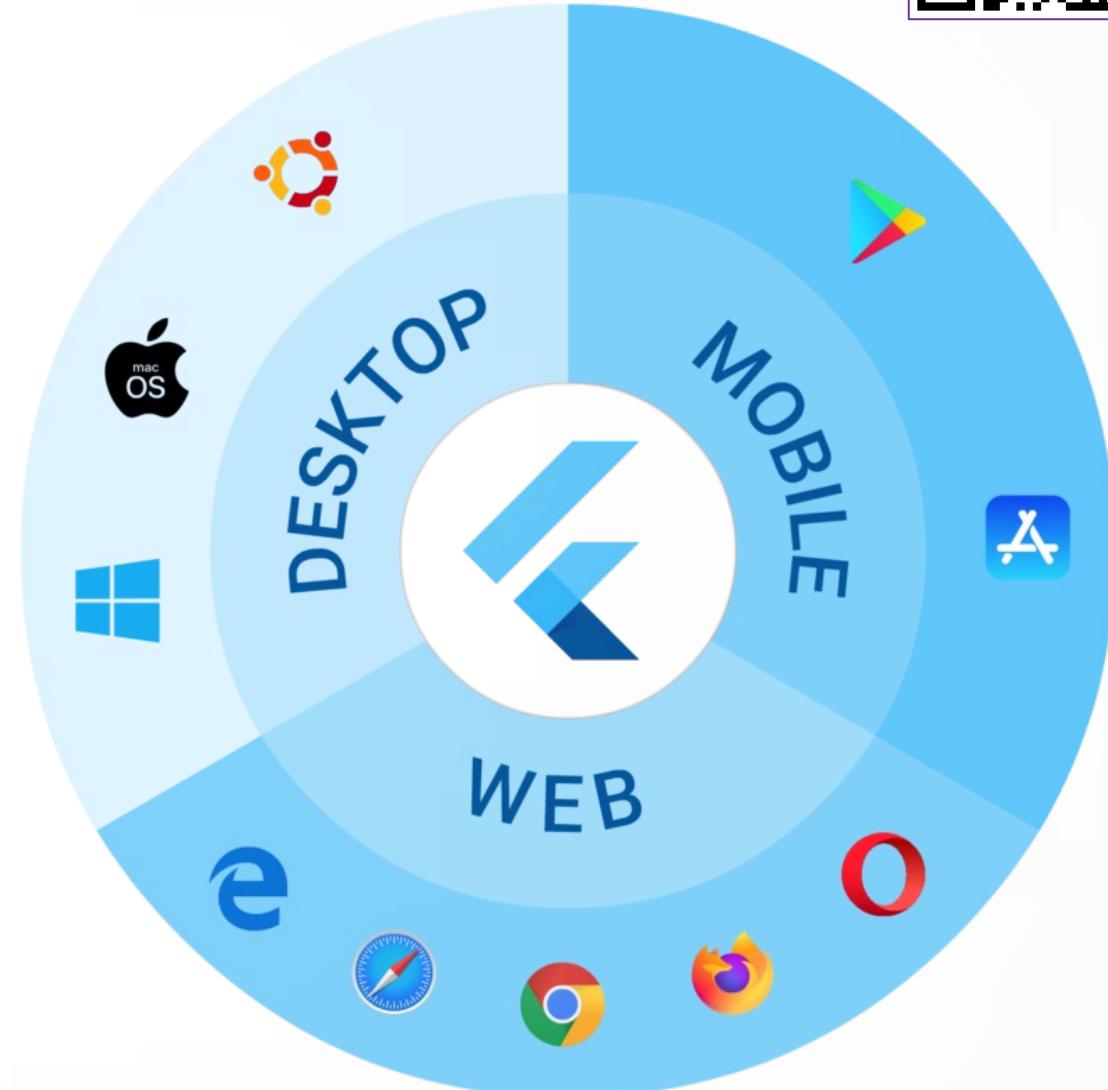
An open-source UI software development kit (SDK) created by Google – Released end of 2018.

Cross-platform app development allows developers to use one programming language and one codebase to build an application for multiple platforms.

Develop **Native Compiled** Applications

- Mobile (iOS, Android)
- Web
- Desktop (Windows, macOS, Linux)

**From a Single codebase!**



<https://medium.com/swlh/flutter-2020-state-of-cross-platform-814f1d8ff16>



# What is Flutter? Dart – Programming Language

## Optimized for UI Development

Dart is designed with a focus on UI development due to its declarative nature.

Its expansive standard library, easy syntax, and features like `async/await` for handling asynchronous operations simplify the development of complex and responsive UIs.

## Ahead-of-Time (AOT) & Just-in-Time (JIT) Compilation

AOT compilation enables Flutter apps to be compiled into optimized, native machine code, ensuring fast startup times and high performance.

JIT compilation allows for hot reload, enabling developers to see code changes in real-time without restarting the app.

Worldwide, Jun 2024 :			
Rank	Change	Language	Share
1		Python	29.06 %
2		Java	15.97 %
3		JavaScript	8.7 %
4		C#	6.73 %
5		C/C++	6.4 %
6	↑	R	4.75 %
7	↓	PHP	4.57 %
8		TypeScript	3.0 %
9		Swift	2.76 %
10		Rust	2.5 %
11		Objective-C	2.39 %
12		Go	2.25 %
13		Kotlin	1.98 %
14		Matlab	1.47 %
15	↑↑↑	Dart	1.02 %
16		Ruby	1.0 %
17	↑↑	VBA	0.96 %
18	↓	Powershell	0.88 %
19	↓↓↓↓	Ada	0.87 %
20		Scala	0.61 %
21		Lua	0.6 %
22	↑	Abap	0.44 %
23	↓	Visual Basic	0.34 %
24		Julia	0.27 %
25	↑	Perl	0.24 %
26	↑↑	Haskell	0.12 %
27	↓↓	Groovy	0.07 %
28	↓	Cobol	0.05 %

<https://pypl.github.io/PYPL.html>



# What is Flutter? Comparisons

Aspect	Flutter	React Native	Xamarin
Language and Framework	<b>Dart</b> , developed by Google	<b>JavaScript</b> and <b>React</b> , developed by Facebook	<b>C#</b> and <b>.NET</b> , developed by Microsoft
Performance	Compiles to native ARM code  High performance	Uses JavaScript bridge  May have performance issues	Compiles to native code  Good performance
Development Experience	Hot reload for instant updates	Hot reload for real-time changes	Hot reload and live reload, more complex management
Community and Ecosystem	Growing community, strong Google backing	Large mature community, extensive resources	Established community, strong Microsoft support
Learning Curve	Easy to learn Dart	Familiar JavaScript Complex React learning	Steeper due to C# and .NET framework complexity
Cost and Licensing	Open-source and free	Open-source and free	Open-source and free Enterprise features may require a subscription

# What is Flutter? Popular Apps by Flutter



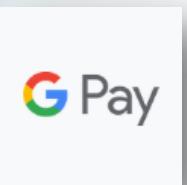
## BMW

My BMW App was launched in July 2020 and has established itself in 47 countries on five continents as a universal interface providing the user a seamless experience between mobile phone and vehicle.



## eBay Motors

eBay Motors ships a new version of their app to both app stores every week. Their apps share 98.3% of their code, the eBay Motors app has a single source of truth – which means one set of meetings, one set of designs, one backlog queue, and one team to manage.



## Google Pay

1.1 million lines of code instead of 1.7 million from previous native versions. At the same time, the team estimates that they've saved about 60-70% of their engineers' time because a single codebase.



## Nubank

Nubank is the largest independent digital bank outside of Asia, giving over 48 million users financial banking tools. Flutter provides more UI consistency. Using native tools, Nubank used to have multiple and inconsistent component libraries.



# Flutter Architecture

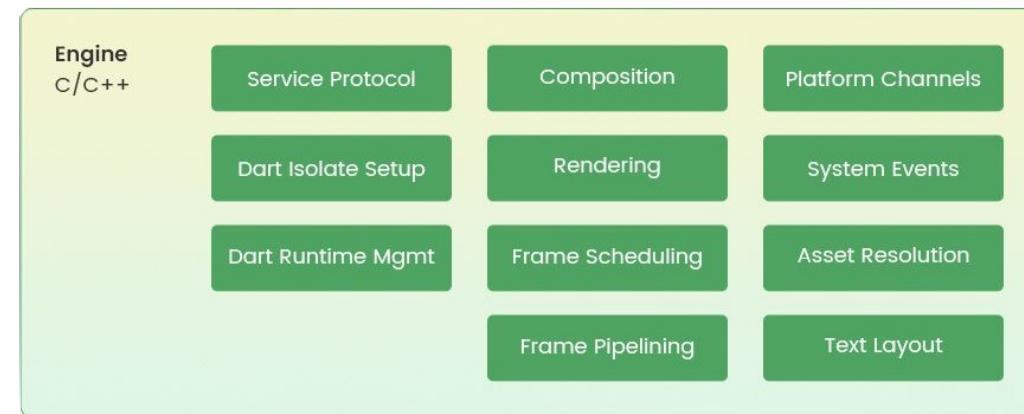
## Flutter Framework

It is a very core part of Flutter app architecture. Flutter framework has got the material parts, widgets, or the Cupertino, and it becomes the foundation element of application development.



## Flutter Engine

Written in C++, this Flutter engine tackles and handles the heavy liftings in software development like the network requests, input, and output, along with managing the complex translations of rendering.



## Embedder

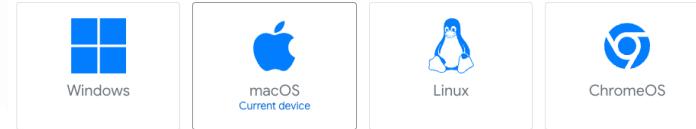
The embedder layers undertake the heavy lifting necessary to translate how Flutter language works with the particular OS.

Flutter user interfaces are developed, composited, and painted by Flutter itself and not translated into a similar OS Widget.



<https://radixweb.com/blog/overview-of-flutter-architecture>

# Setting Up Flutter



## System Requirements

- Windows, Mac, and Linux – All need to be 64bit
- Disk – You will need ~2GB
- GIT by default (*.gitignore added*)

## Flutter Doctor

- Environment Check
- Diagnostic on Miss-Configuration
- Cross Platform Support on different OS Developer machines

```
● (base) → meetup.franklindev.flutter git:(main) ✘ flutter create -e app
Developer identity "Apple Development: Richard Hoehn (GYCQF4QSM4)" selected for iOS code signing
Creating project app...
Resolving dependencies in `app`...
Downloading packages...
Got dependencies in `app`.
Wrote 128 files.

All done!
You can find general documentation for Flutter at: https://docs.flutter.dev/
Detailed API documentation is available at: https://api.flutter.dev/
If you prefer video documentation, consider: https://www.youtube.com/c/flutterdev

In order to run your empty application, type:

$ cd app
$ flutter run

Your empty application code is in app/lib/main.dart.

● (base) → meetup.franklindev.flutter git:(main) cd app
○ (base) → app git:(main) ┌─
```

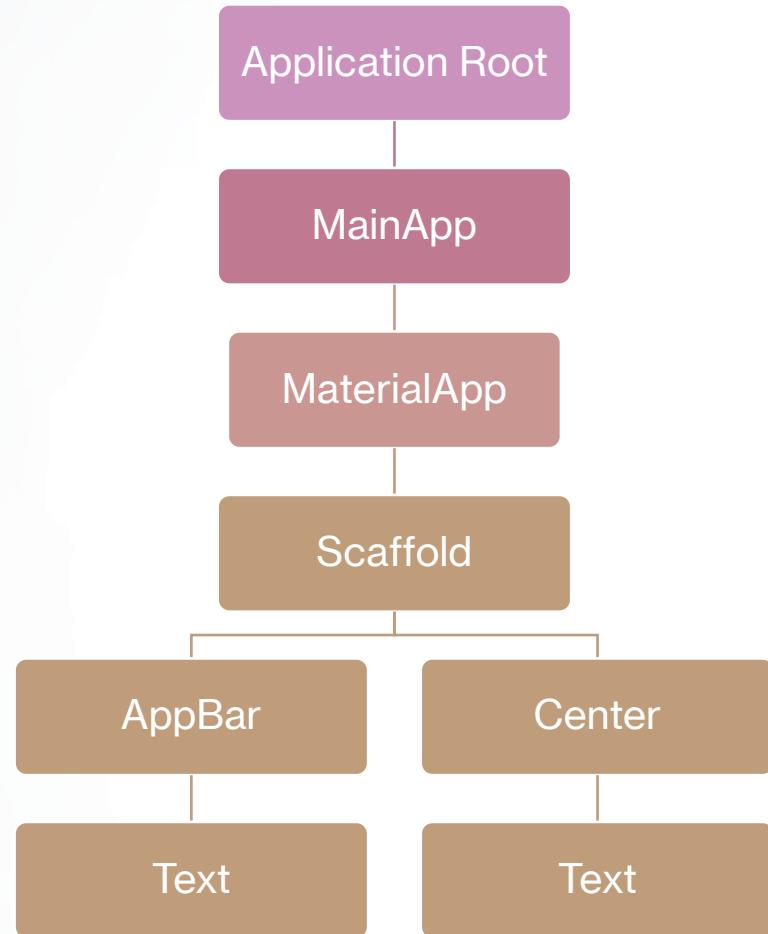
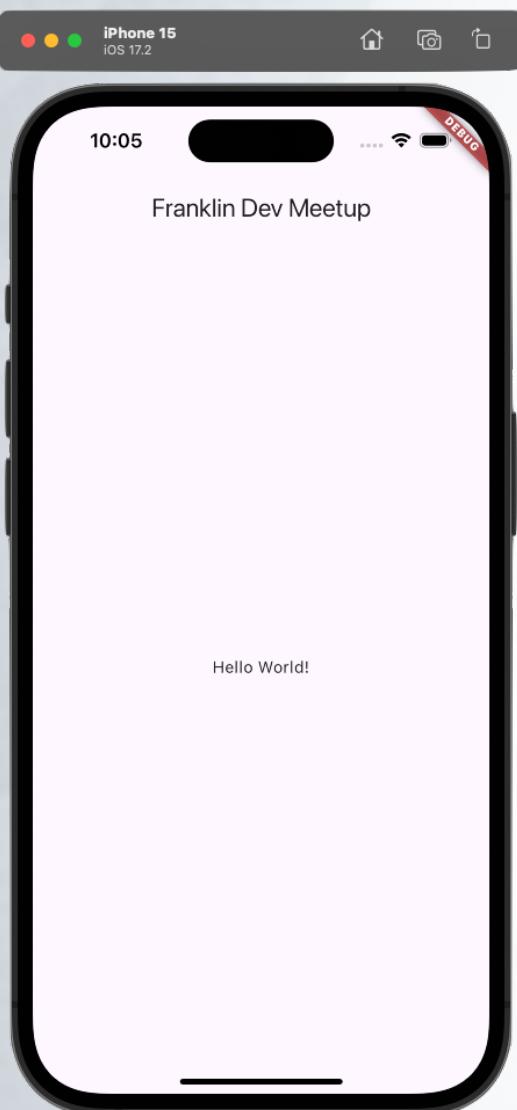
```
● (base) → app git:(main) flutter doctor
Doctor summary (to see all details, run flutter doctor -v):
[✓] Flutter (Channel stable, 3.22.0, on macOS 14.5 23F79 darwin-arm64, locale en-US)
[✓] Android toolchain - develop for Android devices (Android SDK version 33.0.2)
[✓] Xcode - develop for iOS and macOS (Xcode 15.4)
[✓] Chrome - develop for the web
[✓] Android Studio (version 2022.1)
[✓] VS Code (version 1.89.1)
[✓] Connected device (4 available)
[✓] Network resources

• No issues found!
○ (base) → app git:(main) ┌─
```



Flutter

# Widget Tree – All Things are Widgets



```
1 import 'package:flutter/material.dart';
2
3 void main() {
4   runApp(const MainApp());
5 }
6
7 class MainApp extends StatelessWidget {
8   const MainApp({super.key});
9
10 @override
11 Widget build(BuildContext context) {
12   return MaterialApp(
13     home: Scaffold(
14       appBar: AppBar(
15         title: const Text('Franklin Dev Meetup'),
16       ),
17       body: const Center(
18         child: Text('Hello World!'),
19       ),
20     ),
21   );
22 }
23 }
```

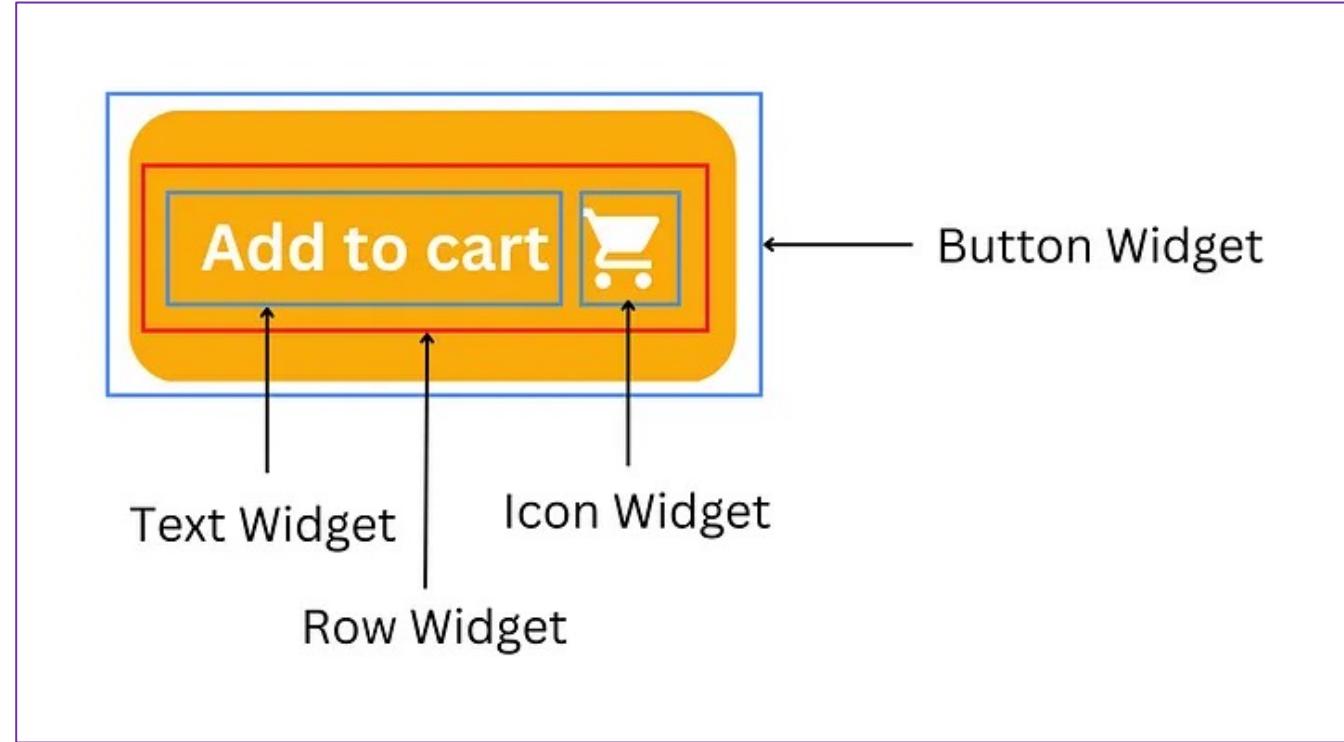
<https://10015.io/tools/code-to-image-converter>

# Widget Tree Nesting of Widgets



```
main.dart

1 class ButtonWidget extends StatelessWidget {
2     const ButtonWidget({super.key});
3
4     @override
5     Widget build(BuildContext context) {
6         return ElevatedButton(
7             onPressed: () {
8                 print('Button Pressed');
9             },
10            child: const Row(
11                children: [
12                    Text('Add to cart'),
13                    Icon(Icons.shopping_cart),
14                ],
15            ),
16        );
17    }
18}
```



<https://medium.com/gytworkz/understanding-flutter-widgets-and-architecture-98ee1f209b96>

# Widget Tree

# Stateful & Stateless Widgets

## Flutter has 2 Types of Widgets

### Stateless & Stateful

#### **Stateless – *Immutable***

...widgets do not contain state hence they can be updated only when it's parent changes.

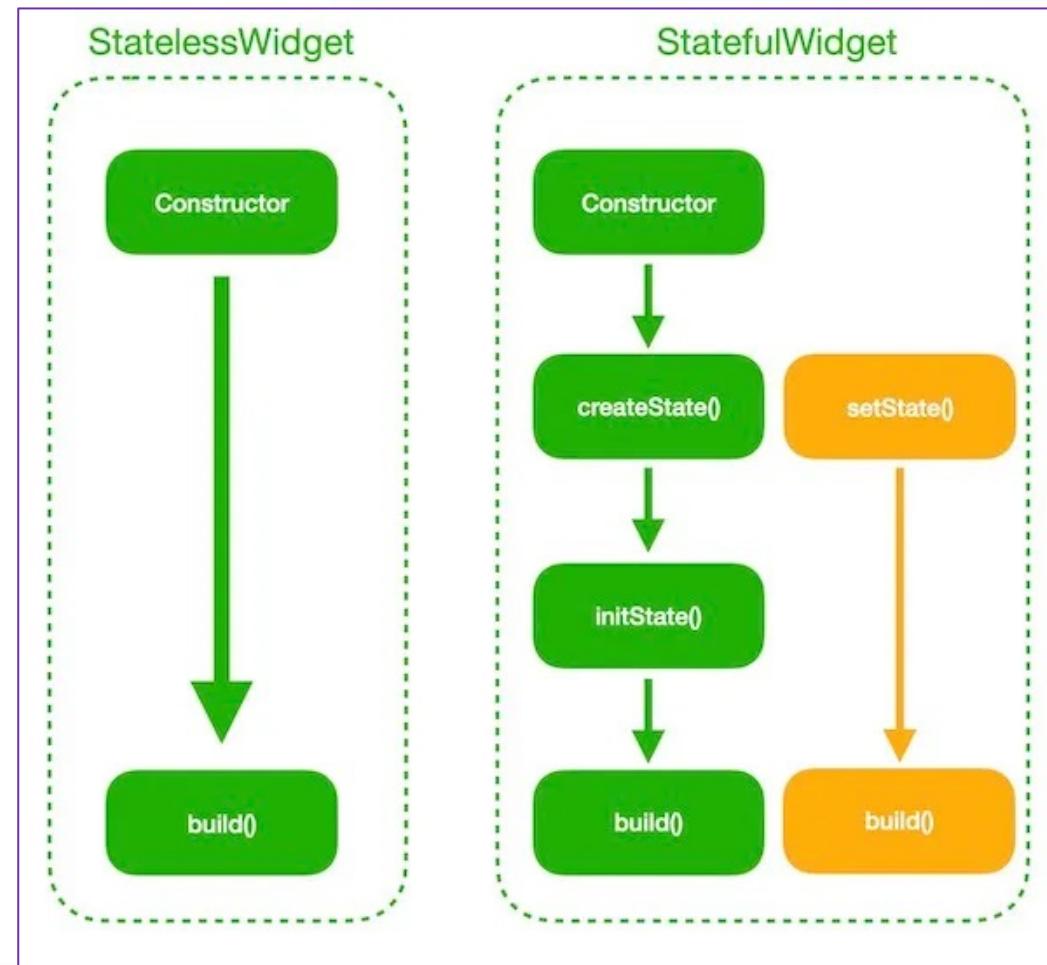
#### **Stateful – *Mutable***

...widgets can hold the states internally, so they can be updated when its states changes and when it's parent changes.

#### **Why?**

...straight forward lifecycle and memory management.

Developers can use stateless widgets for static content and stateful widgets for dynamic content, optimizing both performance and interactivity.



<https://medium.com/gytworkz/understanding-flutter-widgets-and-architecture-98ee1f209b96>



Flutter

# State Management

**Reactive programming updates the (UI) anytime the underlying data (state) changes.**

## **Centralized State Control:**

State management allows you to centralize the control of the application's state, making it easier to manage and update the state consistently across the app.

## **Improved Scalability:**

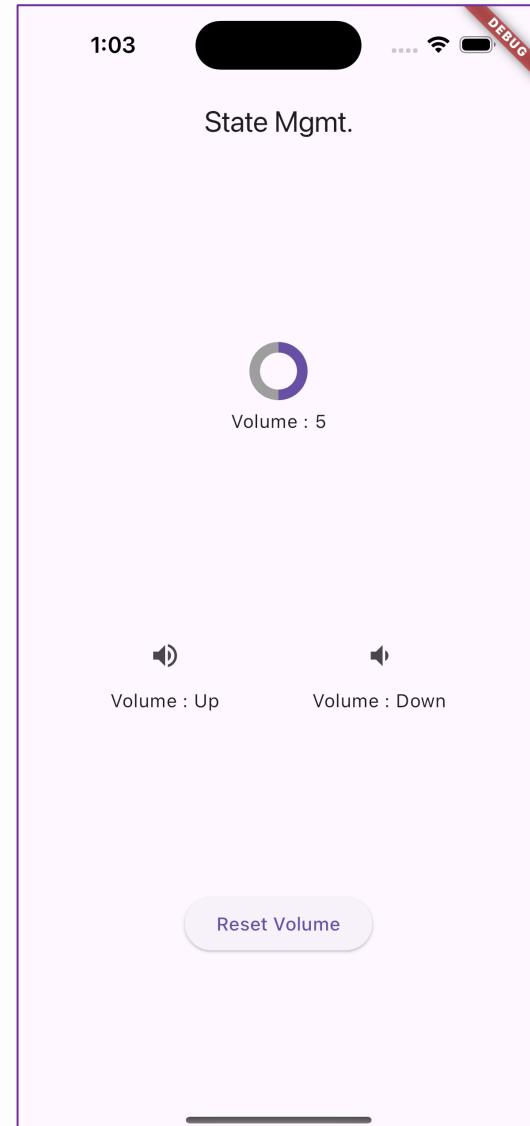
As your application grows, state management helps maintain a clean and organized codebase by separating the UI from the business logic.

## **Enhanced Debugging and Testing:**

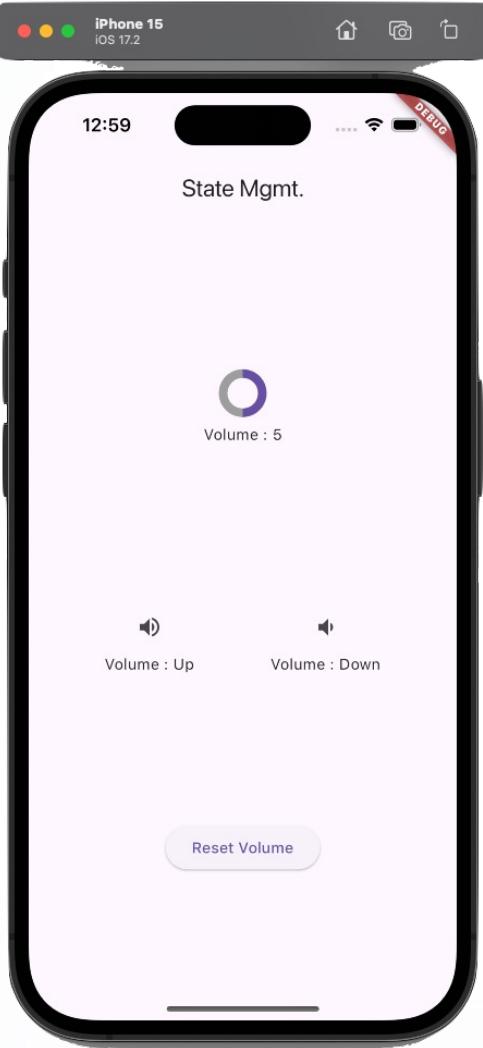
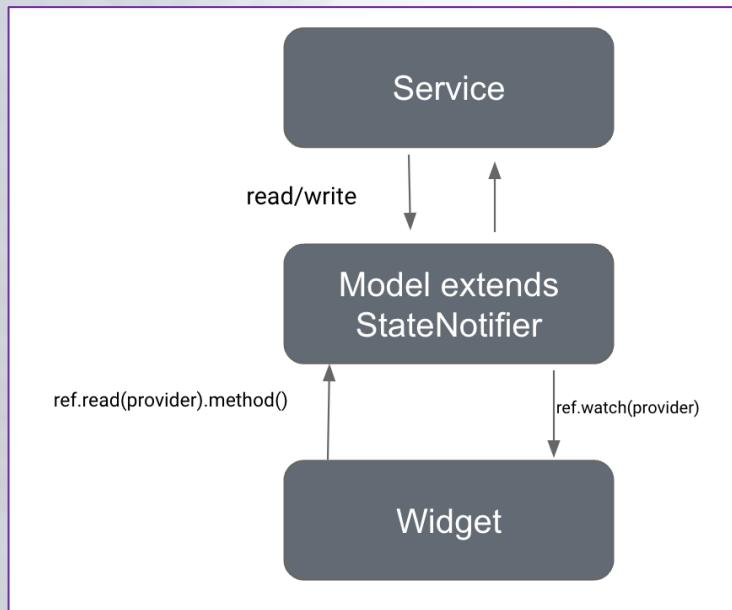
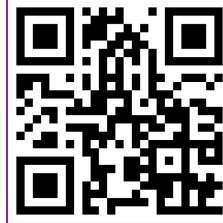
With state management, debugging and testing become more straightforward because the state transitions and changes are controlled and observable.

## **React Native Equivalent:**

This would be Redux or MobX



# State Management Riverpod Example



```

1 import 'package:flutter_riverpod/flutter_riverpod.dart';
2
3 // Define a VolumeNotifier class that extends StateNotifier<int>
4 class VolumeNotifier extends StateNotifier<int> {
5   VolumeNotifier() : super(5);
6
7   // Method to increment the counter
8   void increment() {
9     if (state < 10) {
10       state++;
11     }
12   }
13
14   // Method to decrement the counter
15   void decrement() {
16     if (state > 0) {
17       state--;
18     }
19   }
20
21   // Method to reset the counter
22   void reset() {
23     state = 5;
24   }
25 }
26
27 // Create a provider for the VolumeNotifier
28 final volumeProvider = StateNotifierProvider<VolumeNotifier, int>((ref) {
29   return VolumeNotifier();
30 });
  
```

# Firebase



Provides a set of **Tools & Services** that work together, simplifying the development process.

Offers **real-time data synchronization** and communication

Supports **apps of all sizes**, from small projects to large-scale applications (Note: \$\$\$ pricing like AWS)

## Develop & test your app



### Realtime Database

Store and sync app data in milliseconds



### Crash Reporting

Find and prioritize bugs; fix them faster



### Authentication

Authenticate users simply and securely



### Cloud Functions

Run mobile backend code without managing servers



### Cloud Storage

Store and serve files at Google scale



### Hosting

Deliver web app assets with speed and security



### Test Lab for Android

Test your app on devices hosted by Google

## Grow & engage your audience



### Google Analytics

Get free and unlimited app analytics



### Cloud Messaging

Send targeted messages and notifications



### Dynamic Links

Drive growth by using deep links with attribution



### Remote Config

Modify your app without deploying a new version



### Invites

Make it easy to share your app and content



### App Indexing

Drive search traffic to your mobile app



### AdMob

Maximize revenue with in-app ads



### AdWords

Drive installs with targeted ad campaigns

# Firebase Four (4) Key Modules I use



## Authentication

Firebase Authentication provides an easy way to handle user authentication. It supports various authentication methods such as email/password, Google, Facebook, and phone number authentication. This allows you to securely authenticate users without having to build your own backend authentication system.



## Realtime Database and Firestore

Firebase offers two cloud-hosted database solutions: Realtime Database and Firestore. Realtime Database is a NoSQL database that stores data in a **JSON** format and synchronizes data in real-time across all clients. Firestore, on the other hand, is a more flexible and scalable NoSQL database that supports complex querying and offline data access.



## Cloud Functions

Firebase Cloud Functions (*AWS Lambda*) allow you to run backend code in response to events triggered by Firebase features and HTTPS requests. This serverless architecture helps you execute code without managing servers, enabling you to extend the functionality of your Flutter app with custom backend logic.



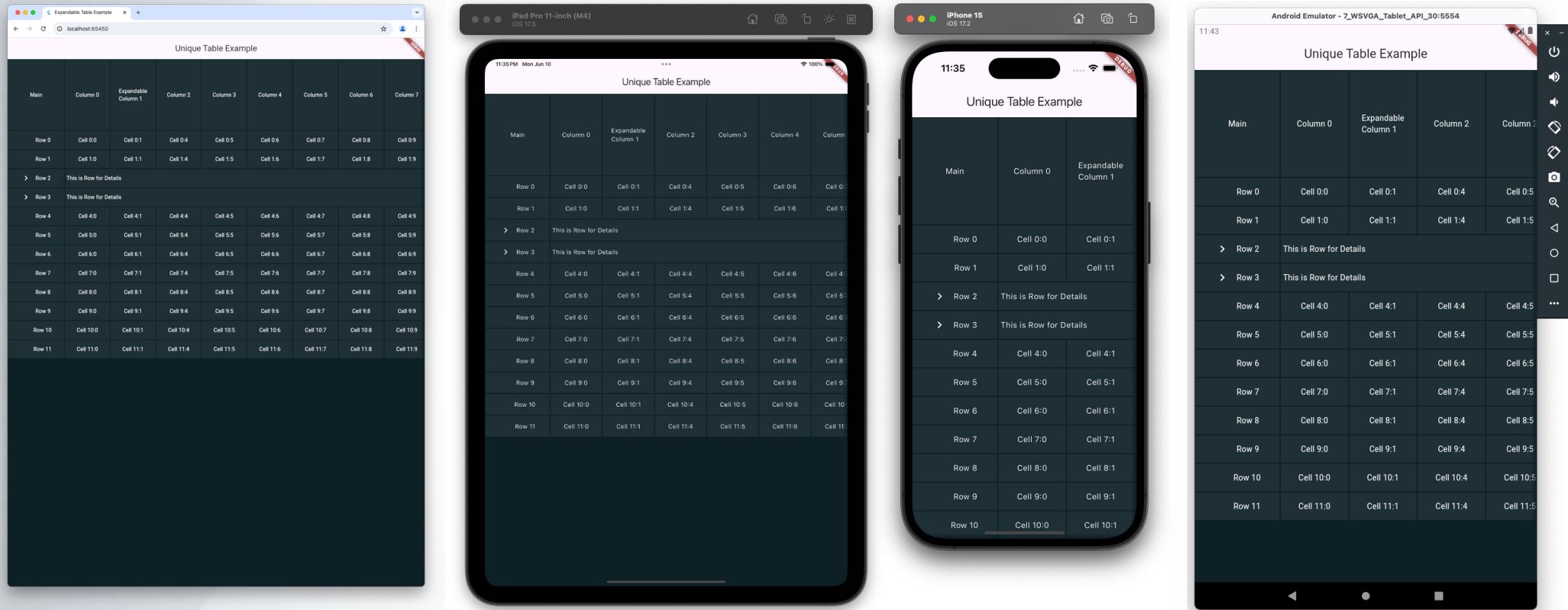
## Analytics and Performance Monitoring

Firebase Analytics provides insights into user behavior and engagement, helping you understand how users interact with your app. Additionally, Firebase Performance Monitoring offers real-time performance data, allowing you to identify and fix performance issues.

# Unique Features of Flutter

Consistent UI across platforms due to custom rendering engine!

## Demo Example!



[https://pub.dev/packages/flutter\\_expandable\\_table/example](https://pub.dev/packages/flutter_expandable_table/example)



Flutter

