



Flutter



Exploring Flutter

A powerful Tool for Cross-Platform App Development



GitHub Repo



GitHub PDF

Franklin Developer Lunch & Learn

Meetup – Franklin, TN, USA

By Richard Hoehn – June 2024

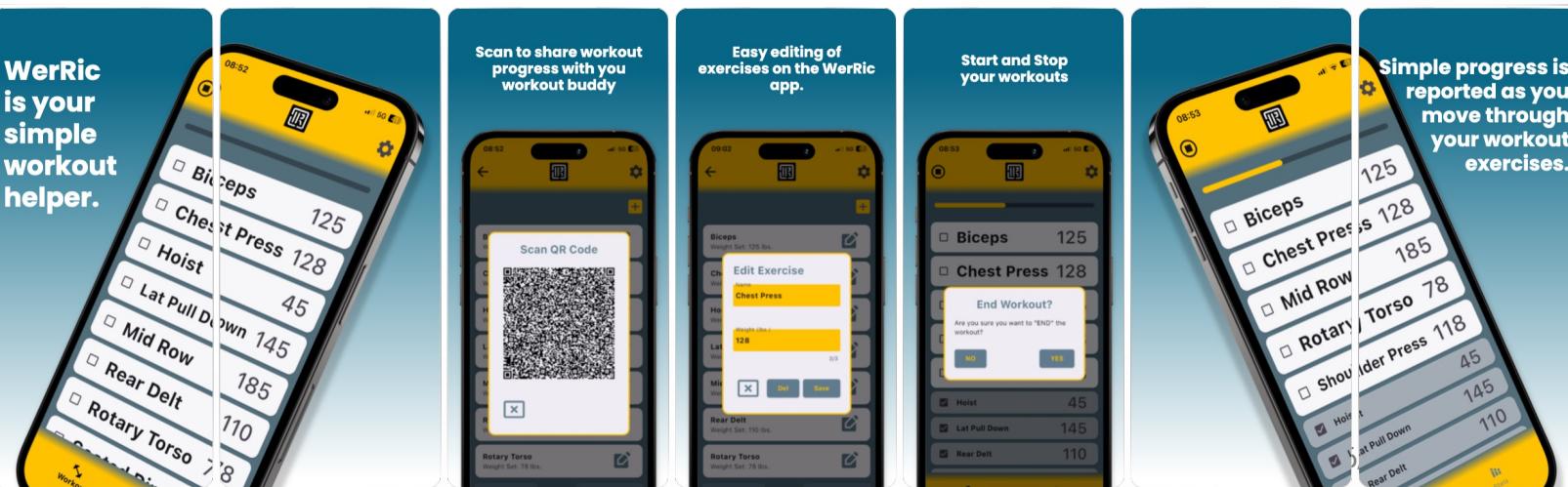


Flutter

About Me

Living in Franklin, TN
since 98

- Grew up in Switzerland
Zurich Area
- Machinist by Trade
CNC Programmer
- PLC – Ladder Logic
- Embedded C – ARM & AVR
- App & Web Development



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 Good Documentation
- *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 the Google backend enables scalable development
- Review of Unique Features and Demo





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.

Your Code is **Native Compiled** to

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

Released by Google - 2011

Optimized for UI Development

- Dart is designed with a focus on UI development due to its declarative nature.
- Its expansive standard library and easy syntax 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? Dart – Declarative

Declarative Style:

The UI is built using a tree of widgets that describe the structure and appearance of the app at any given state.

State Management:

The state is managed using the setState method to trigger a rebuild of the UI with the new state.

Readability:

The code is easy to read and understand because it focuses on what the UI should look like, not how to construct it step by step.



```
1 class _GreetingScreenState extends State<GreetingScreen> {
2   bool _isHello = true;
3
4   void _toggleGreeting() {
5     setState(() {
6       _isHello = !_isHello;
7     });
8   }
9
10 @override
11 Widget build(BuildContext context) {
12   return Scaffold(
13     appBar: AppBar(title: Text('Declarative Programming')),
14     body: Center(
15       child: Column(
16         mainAxisAlignment: MainAxisAlignment.center,
17         children: <Widget>[
18           Text(
19             _isHello ? 'Hello, World!' : 'Goodbye, World!',
20             style: TextStyle(fontSize: 24),
21           ),
22           SizedBox(height: 20),
23           ElevatedButton(
24             onPressed: _toggleGreeting,
25             child: Text('Toggle Greeting'),
26           ),
27         ],
28       ),
29     ),
30   );
31 }
32 }
```

What is Flutter? Comparisons

Aspect	Flutter	React Native	Xamarin
Language and Framework	Dart , developed by Google	JavaScript and React , developed by Facebook	C# and .NET , 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



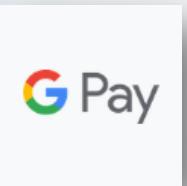
BMW

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

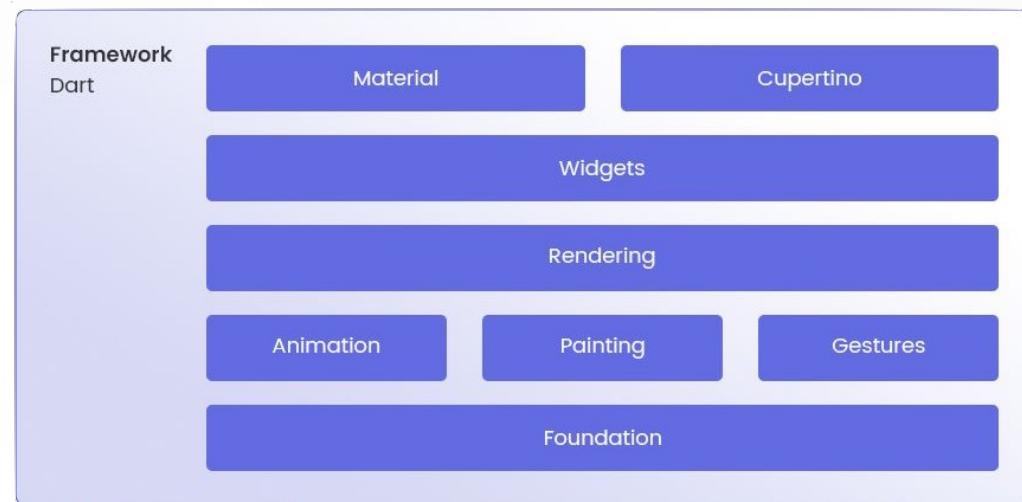
Nubank is the largest independent digital bank outside of Asia, giving over 48 million users financial banking tools. Flutter provides more UI consistency.



Flutter Architecture

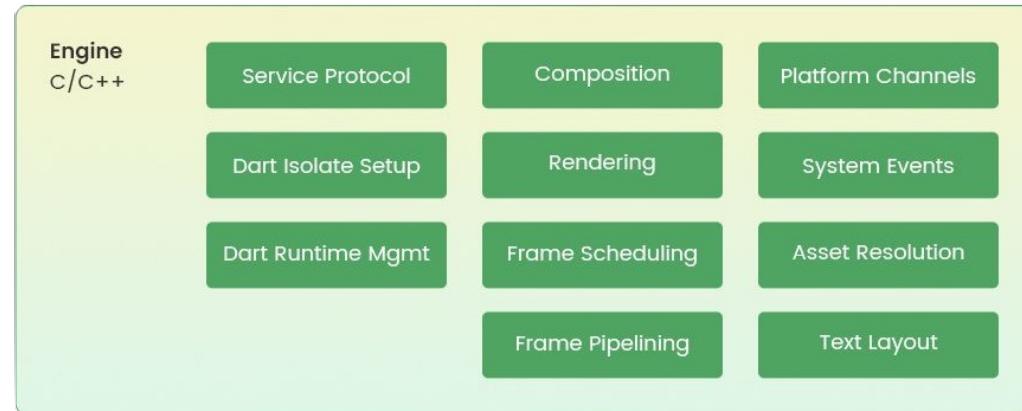
Flutter Framework – *Developers Work Here*

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 – *Google Team Works Here*

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 – *Specific to Deployment OS*

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) ┌─
```



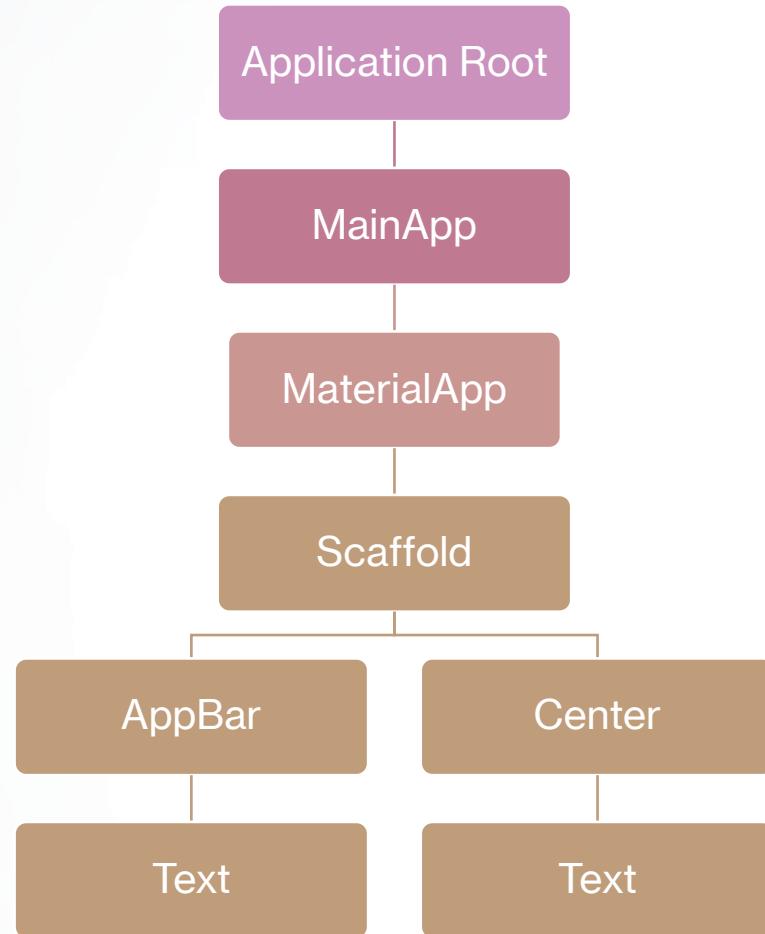
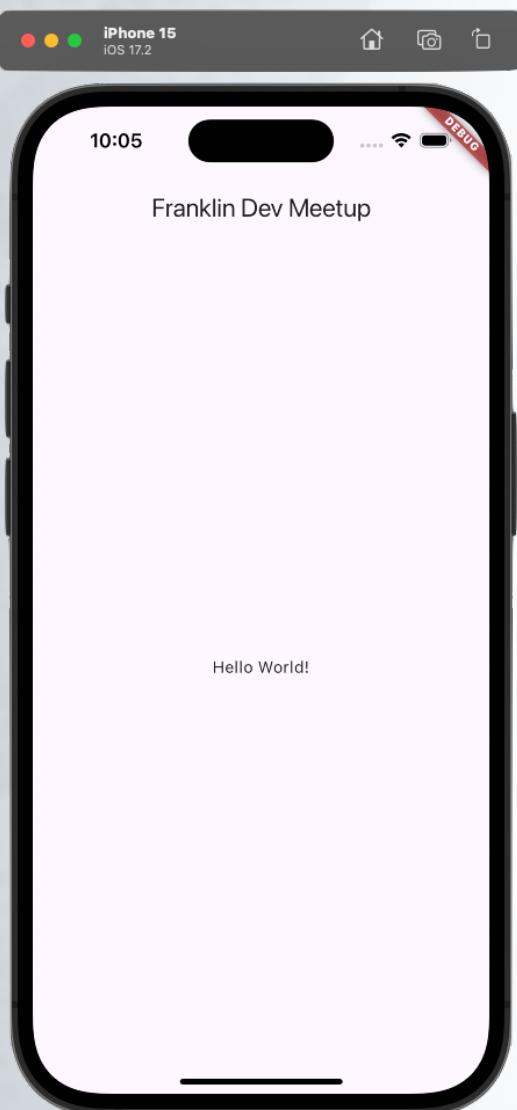
```
● (base) → app git:(main) flutter doctor
Doctor summary (to see all details, run flutter doctor -v):
[✓] Flutter (Channel stable, 3.22.0, on macOS 14.5 23F79 darwin-arm64, locale en-US)
[✓] Android toolchain - develop for Android devices (Android SDK version 33.0.2)
[✓] Xcode - develop for iOS and 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 }
```

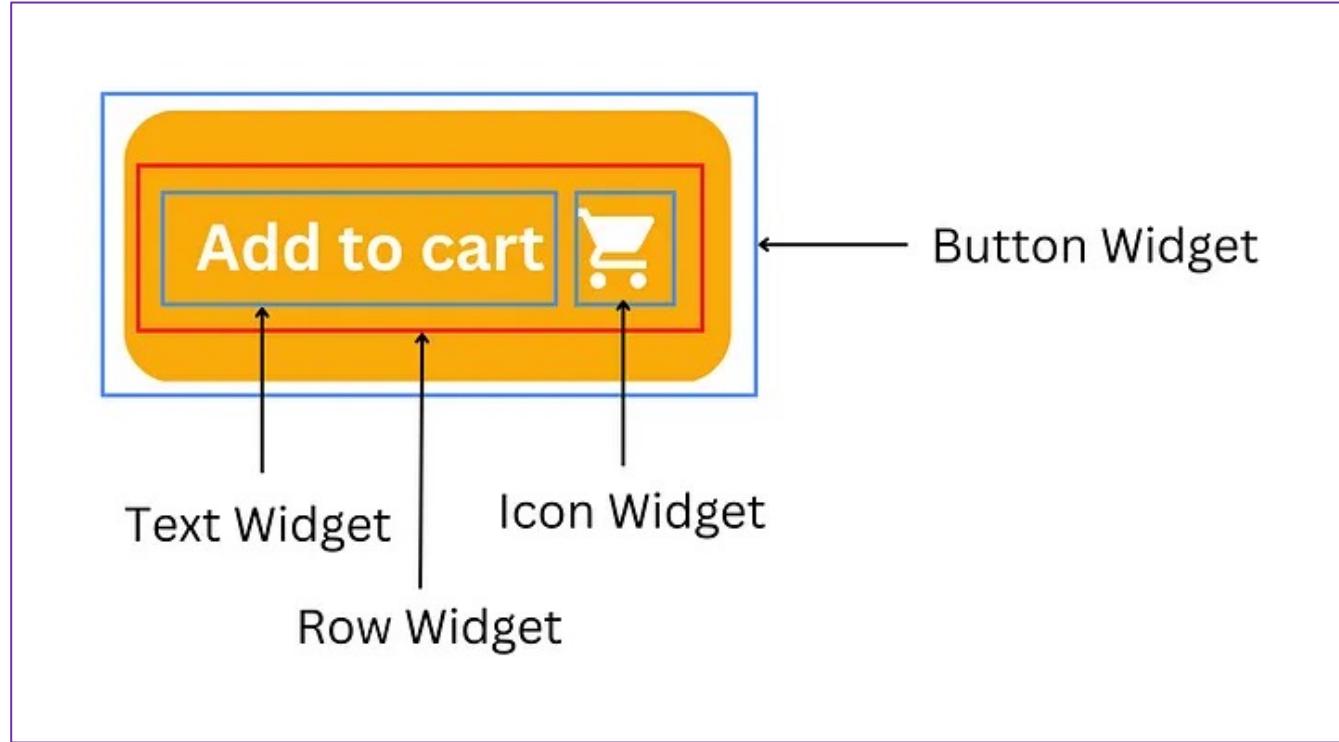
<https://10015.io/tools/code-to-image-converter>

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.

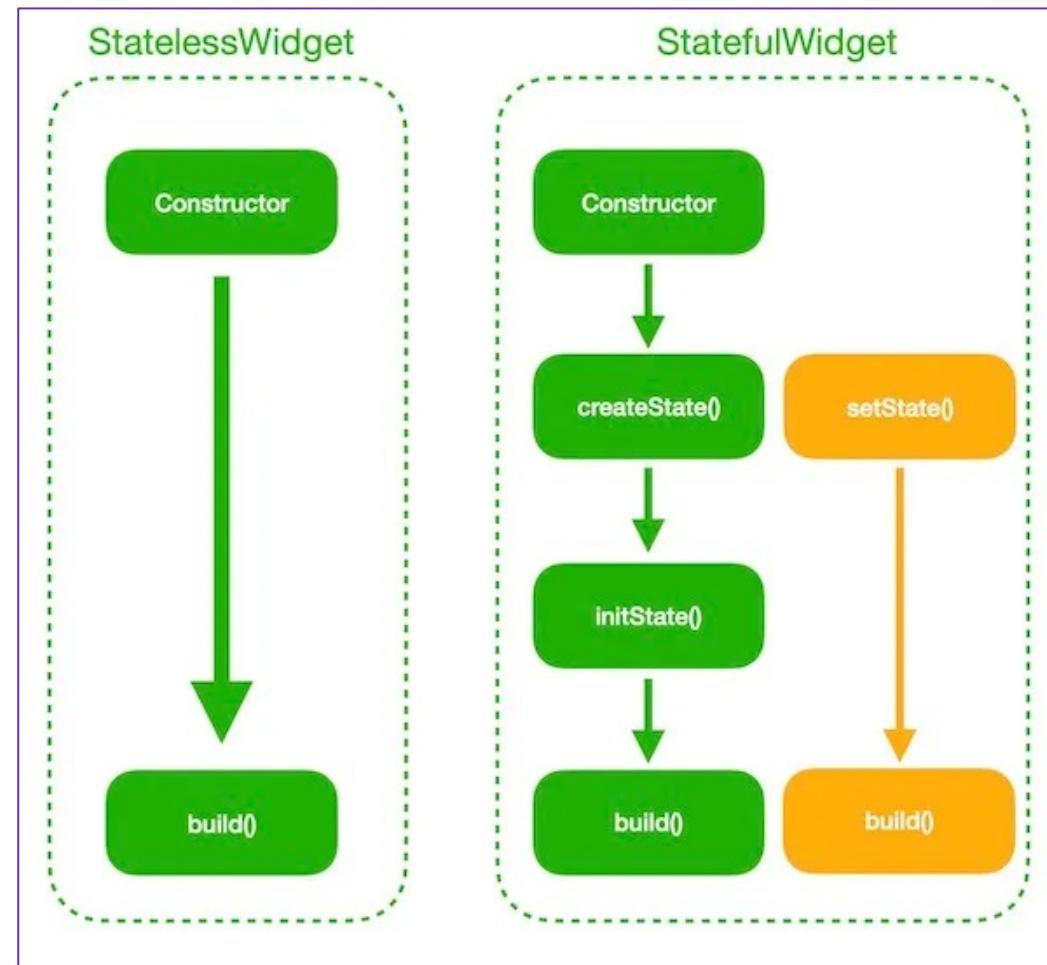
Stateful – *Mutable*

...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:

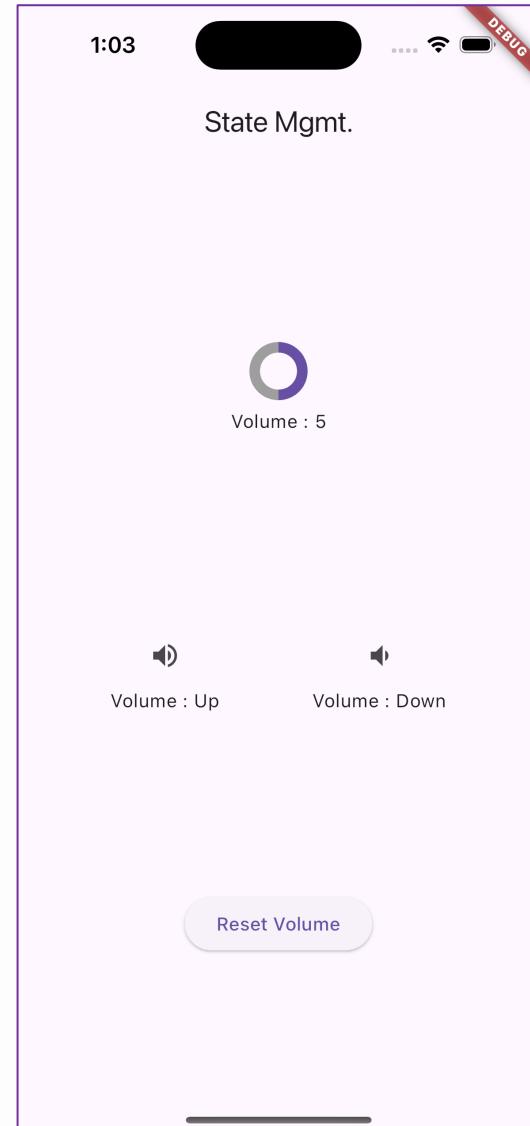
As your application grows, state management helps maintain a clean and organized codebase by separating the UI from the business logic.

Enhanced Debugging and Testing:

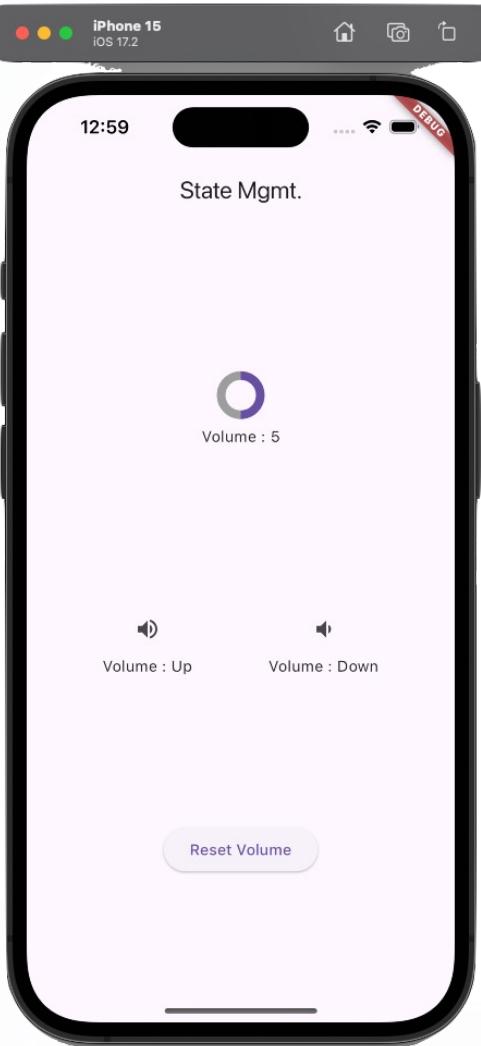
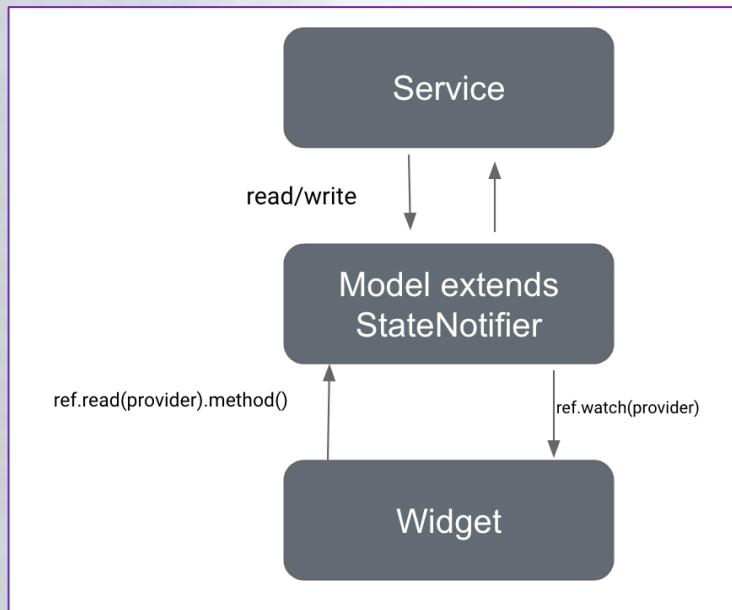
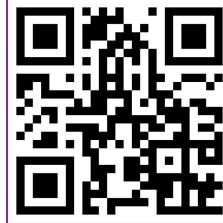
With state management, debugging and testing become more straightforward because the state transitions and changes are controlled and observable.

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.



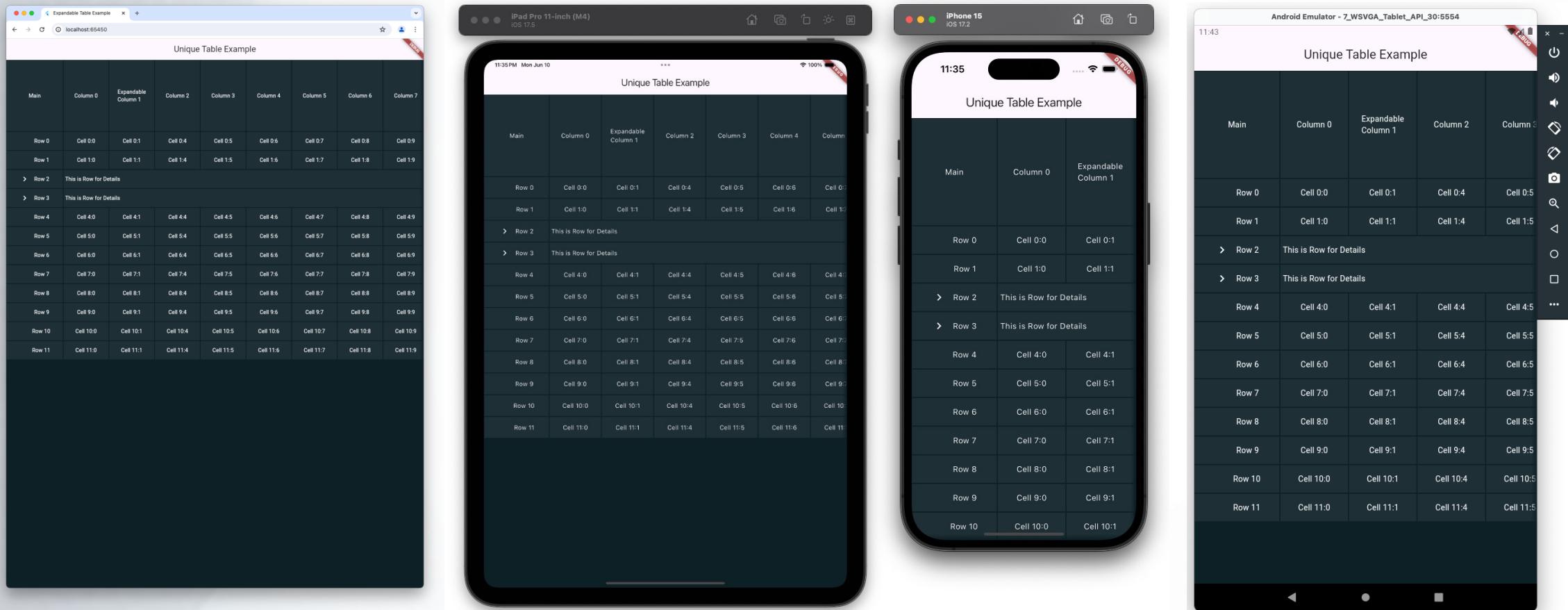
Analytics and Performance Monitoring

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



Flutter

