Flutter Basics: A Detailed Note

What is Flutter?

Flutter is an open-source UI software development toolkit created by Google. It is used to build natively compiled applications for **mobile (iOS, Android)**, **web**, and **desktop** from a single codebase. Flutter uses **Dart**, an object-oriented programming language, as its primary language.

Key Features of Flutter

1. **Hot Reload**:
    - Instantly see changes in the code reflected in the app without restarting the application.
2. **Single Codebase**:
    - Write one set of code that works on multiple platforms.
3. **Widgets**:
    - Everything in Flutter is a widget, from layout elements to UI components.
4. **High Performance**:
    - Flutter apps run directly on the device's GPU for smooth rendering.
5. **Customizable UI**:
    - Offers extensive flexibility for creating unique and engaging UIs.

Flutter Architecture

1. **Widgets**:
    - Widgets are the building blocks of a Flutter application.
    - Two main types of widgets:
        - **StatelessWidget**: Immutable; doesn't maintain state.
        - **StatefulWidget**: Can change over time and maintain state.
2. **State**:
    - The information that can change over time or based on user interactions.
3. **BuildContext**:
    - Represents the location of a widget in the widget tree.
4. **Flutter Framework Layers**:
    - **Framework**: Composed of widgets and libraries.
    - **Engine**: Handles rendering and core APIs (written in C++).
    - **Embedder**: Integrates the engine with platform-specific APIs.

Key Concepts in Flutter

1. **Widget Tree**:
    - Flutter uses a tree-like structure for widgets.
    - Parent widgets can contain multiple child widgets.

Example:

```
 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("Flutter Basics")),
        body: Center(
          child: Text("Hello, Flutter!"),
        ),
      ),
    );
  }
}
```

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2. **StatelessWidget vs StatefulWidget**:
    - **StatelessWidget**:
        - Use for UI elements that don’t change.

Example:

```
 class MyWidget extends StatelessWidget {
  @override
  Widget build(BuildContext context) {
    return Text("I am Stateless");
  }
}
```

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    - **StatefulWidget**:
        - Use for elements that change based on user interaction.

Example:

```
 class MyWidget extends StatefulWidget {
  @override
  _MyWidgetState createState() => _MyWidgetState();
}

class _MyWidgetState extends State<MyWidget> {
  int counter = 0;

  @override
  Widget build(BuildContext context) {
    return Column(
      children: [
        Text("Counter: $counter"),
        ElevatedButton(
          onPressed: () {
            setState(() {
              counter++;
            });
          },
          child: Text("Increment"),
        ),
      ],
    );
  }
}
```

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3. **Material Design and Cupertino**:
    - Flutter provides pre-designed widgets based on:
        - **Material Design** (Android).
        - **Cupertino** (iOS).
    - Example:
        - Material Button: `ElevatedButton()`
        - Cupertino Button: `CupertinoButton()`
4. **Widget Lifecycle**:
    - For **StatefulWidget**, lifecycle methods include:
        - `initState()`: Called when the widget is initialized.
        - `build()`: Called to render the widget.
        - `dispose()`: Called when the widget is removed from the tree.

Flutter Development Workflow

1. **Install Flutter**:
    - Install Flutter SDK and set up an IDE (e.g., VS Code or Android Studio).
2. **Create a New Project**:
    - Run `flutter create project_name`.
3. **Write Code**:
    - Use Dart to build the widget tree and logic.
4. **Run the App**:
    - Use `flutter run` to launch the app on an emulator or physical device.
5. **Debugging**:
    - Use Flutter's DevTools for debugging and profiling.

Understanding the Widget Tree

1. **Parent-Child Relationship**:
    - Widgets are nested.

Example:

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

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2. **Common Widgets**:
    - **Text**: Displays simple text.
    - **Container**: A box model widget with padding, margin, and alignment.
    - **Row/Column**: Layout widgets to arrange children horizontally or vertically.
    - **Stack**: Overlays widgets on top of each other.

Building a Simple App

```
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("My Flutter App")),
        body: Center(
          child: Column(
            mainAxisAlignment: MainAxisAlignment.center,
            children: [
              Text("Welcome to Flutter"),
              ElevatedButton(
                onPressed: () {
                  print("Button Pressed!");
                },
                child: Text("Press Me"),
              ),
            ],
          ),
        ),
      ),
    );
  }
}
```

Best Practices for Flutter Basics

1. **Follow Dart and Flutter Coding Conventions**:
    - Use camelCase for variables and methods.
2. **Use StatelessWidget Whenever Possible**:
    - Saves memory and improves performance.
3. **Keep UI Clean**:
    - Use modular widget design to separate UI components.
4. **Optimize Performance**:
    - Use const constructors wherever applicable.
    - Minimize widget rebuilding using efficient state management.