

Biomedical Wearable Technologies
for Healthcare and Wellbeing

State Management

A.Y. 2023-2024

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Outline

- **State management concepts**

- Provider

- Case study

- Other Provider classes

- Exercise

- Homework

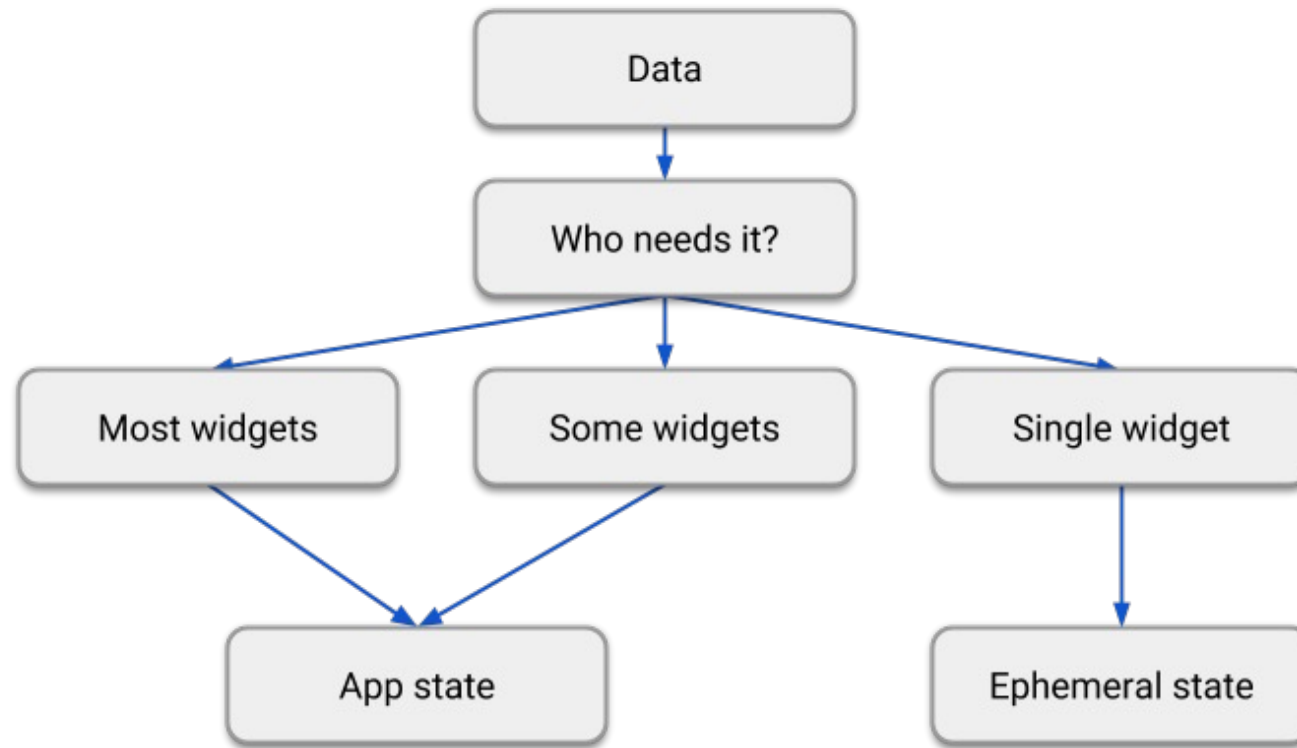
- Resources

State

- State stands for everything that is necessary to define how the app and its screen behave and look at some point in time:
 - Assets
 - Variables
 - Fonts
 - ...
- Conceptually can be divided in:
 - **Ephemeral state**: sometimes called *local state*, what can be strictly contained in a Widget
 - **App state**: sometimes called *shared state*, things that you want to share across many parts of the app

State

- There is no universal rule to choose if a variable is part of the ephemeral state or the app state. A diagram that can help:



Remember: Flutter is declarative

- Flutter is a declarative framework

$$\text{UI} = f(\text{state})$$

The layout
on the screen

Your
build
methods

The application state

- State is changed? Build methods are called and the UI is refreshed.

So far...

- So far, we had a grasp on state management:
 - Stateful widgets: their state can change through time
 - Stateless widgets: their state cannot change though time
- We need to understand how to change state when something occurs (e.g., a button is pressed, data change,...) and reflect those changes to the UI (rebuilding it).
- In lesson 4, we used `setState()`:

So far...

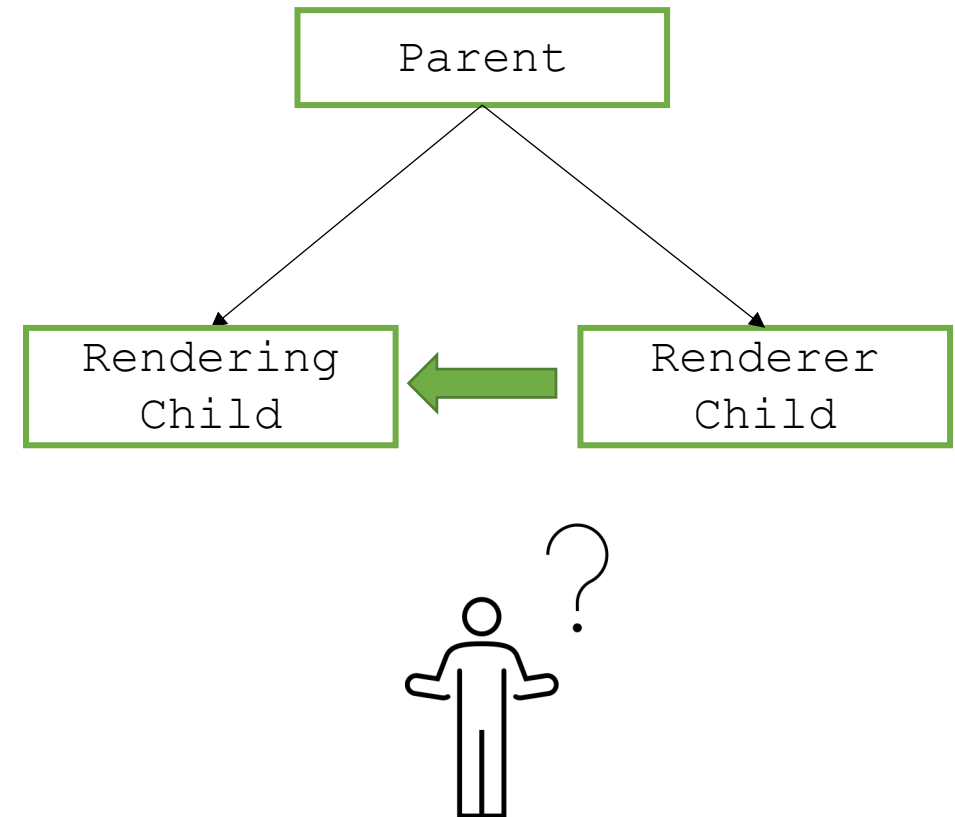
➤ In lesson 4, we used setState():

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

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

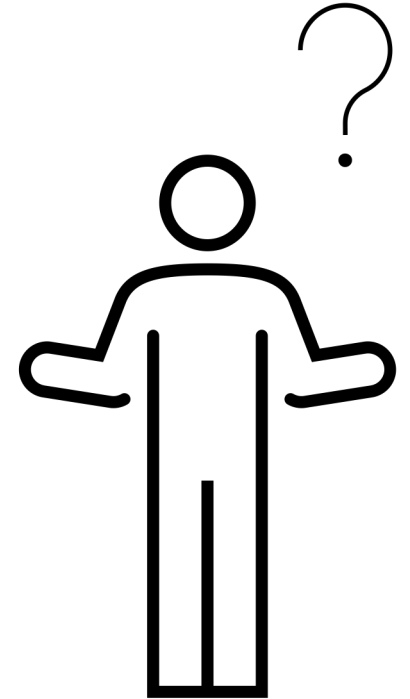
The limitation

- Why we cannot fully depend on this approach?
- In a typical widget tree, when two children of a parent are not in the same class as of the parent, rendering one child from another becomes impossible until and unless you involve the parent for the same.
- You either have to call a `setState()` from parent which in turn renders both children or pass a callback function from one child to another child via the Parent.
- In other words, app state is very messy to handle



So, how to manage state?

- There is no such a thing as a “*universal way to manage state*”
- Actually, there are a lot of possible approaches:
 - Provider
 - Riverpod
 - Redux
 - BLoC
 - ...
- Every approach has its PROs and CONs. So?
- Here, we will discuss **Provider**, the recommended approach by the Flutter community.



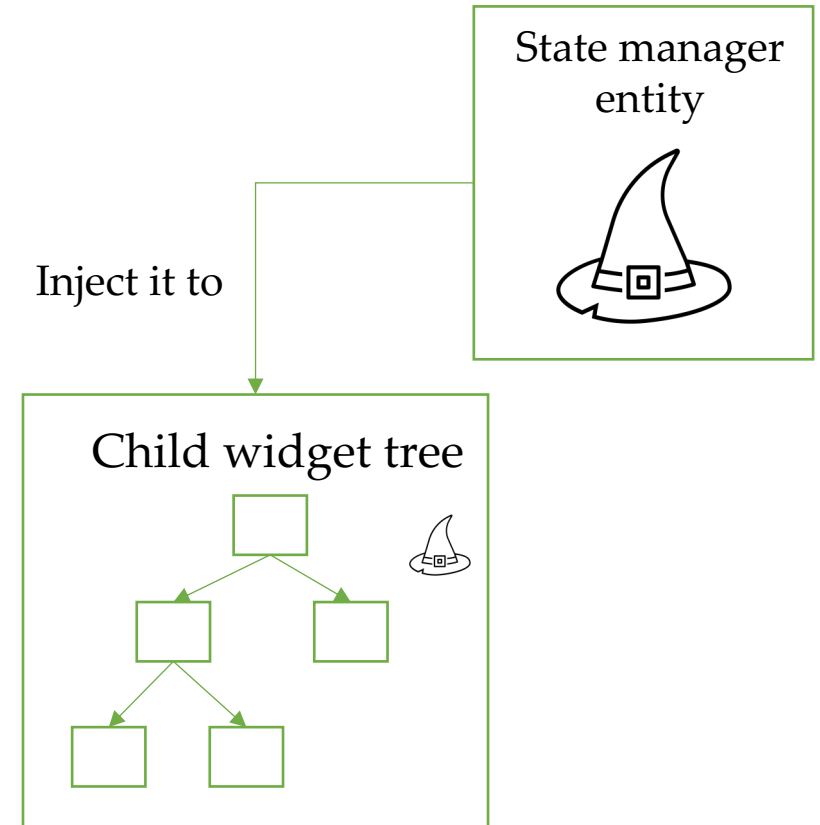
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Provider core idea

- Provider wants to provide!
- The core idea is to provide the entity (one or more classes) in charge of maintaining the state down through the widget tree
- Each child will be able to access to the entity and react to state changes.



Provider classes

➤ Provider implement a set of classes, here's the most important:

- `ChangeNotifier`
- `ChangeNotifierProvider`
- `Consumer`
- `FutureProvider/StreamProvider`
- `MultiProvider`
- `ProxyProvider`

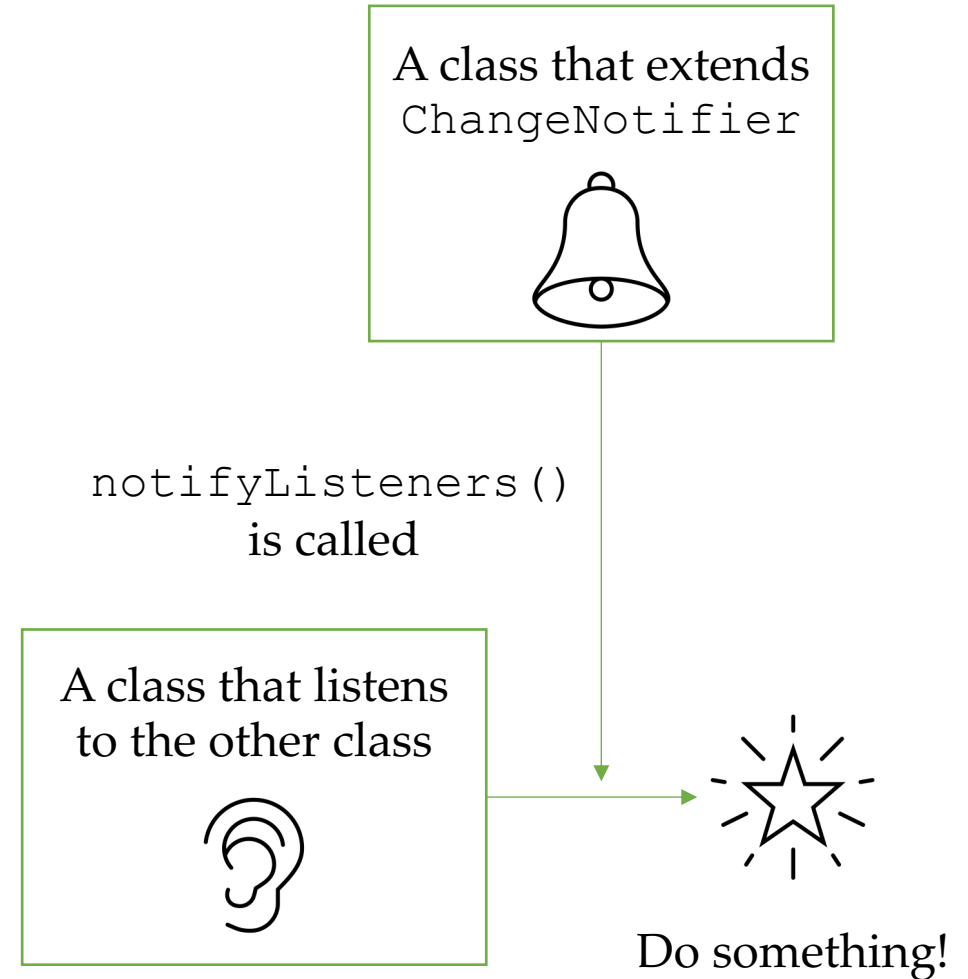
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Provider classes: ChangeNotifier

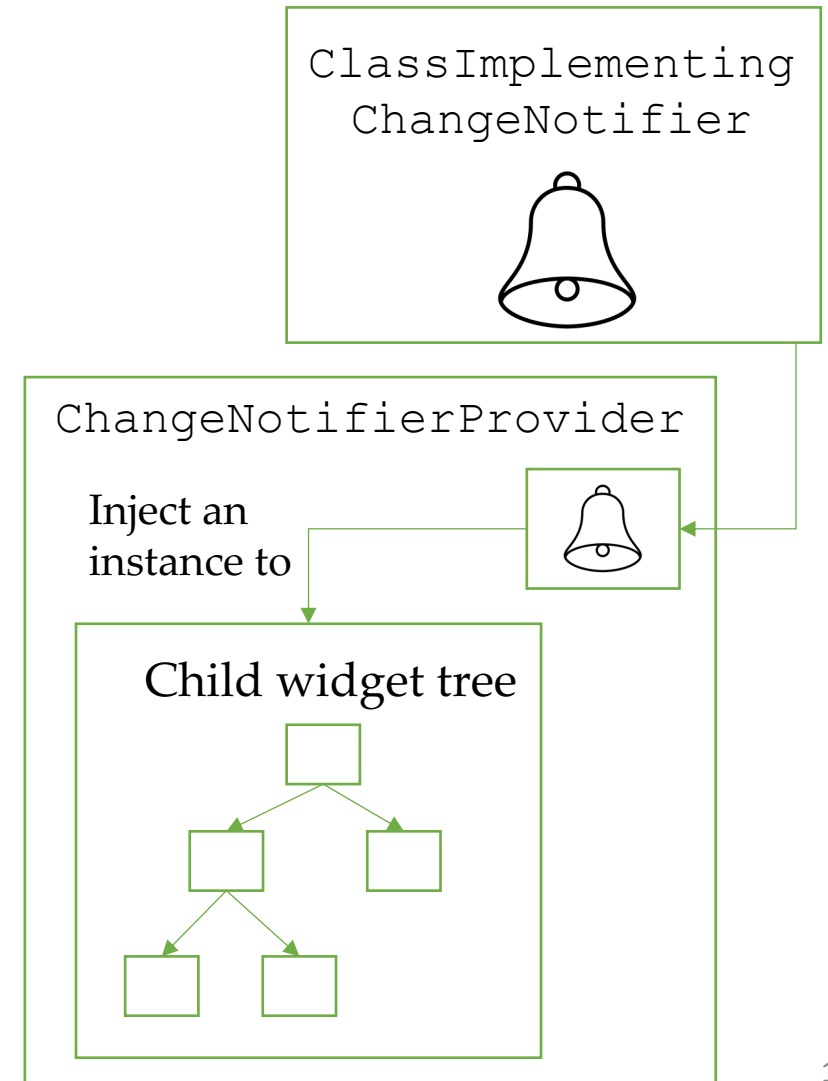
- ChangeNotifier is a class that can notify **listeners** of any changes in the state.
- You usually extend the ChangeNotifier for models so you can send notifications when your model changes.
- When something in the model changes, you call **notifyListeners()** and whoever is listening can use the newly changed model.



Provider classes: ChangeNotifierProvider

- ChangeNotifierProvider is a class that wraps a class that implements ChangeNotifier and **provide it** to its descendants.
- Now the widget tree can access to it (and use it!)
- Synthax:

```
ChangeNotifierProvider(  
  create: (context) =>  
    ClassImplementingChangeNotifier(),  
  child: <widget_tree>,  
);
```

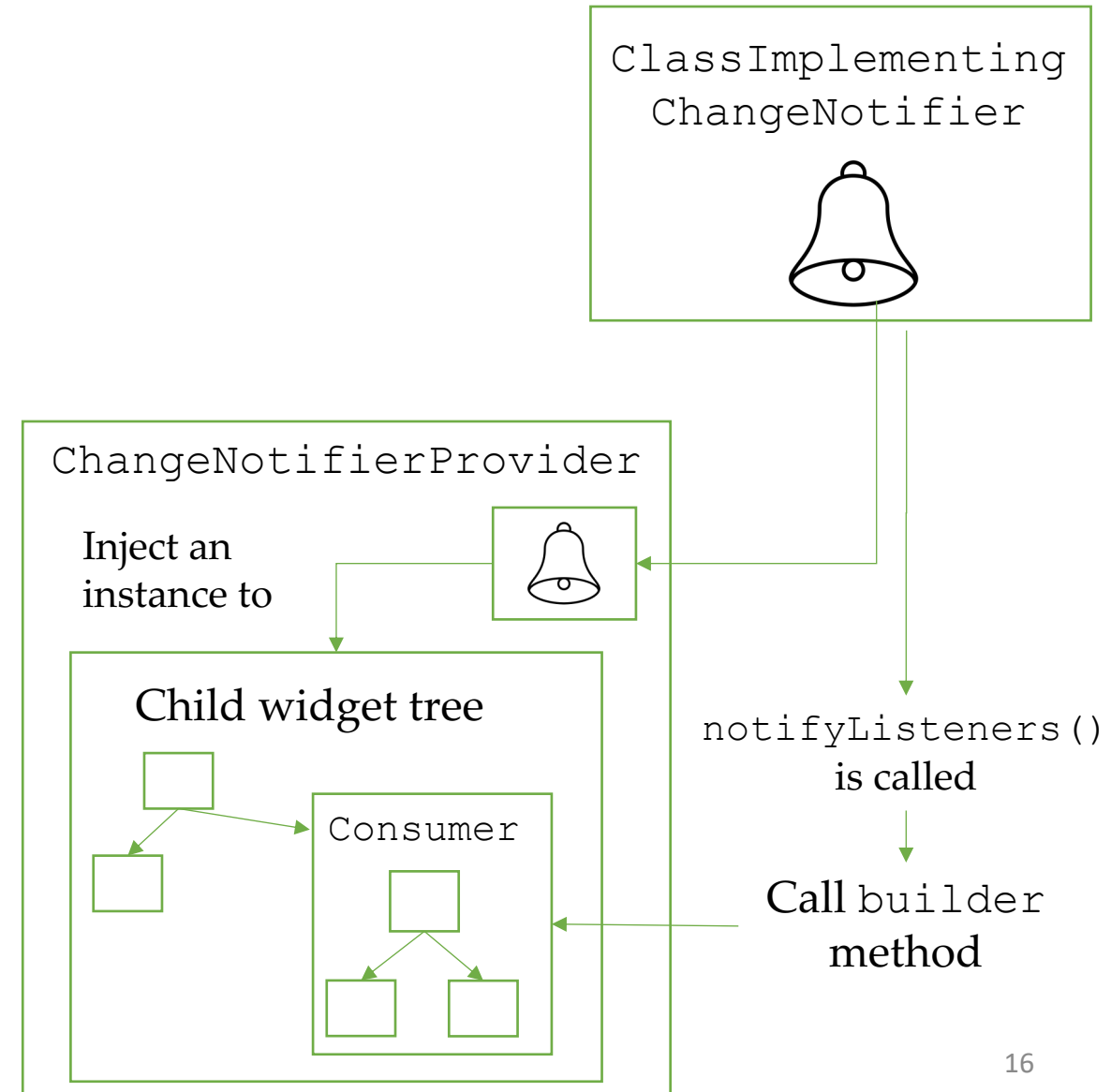


Provider classes: Consumer

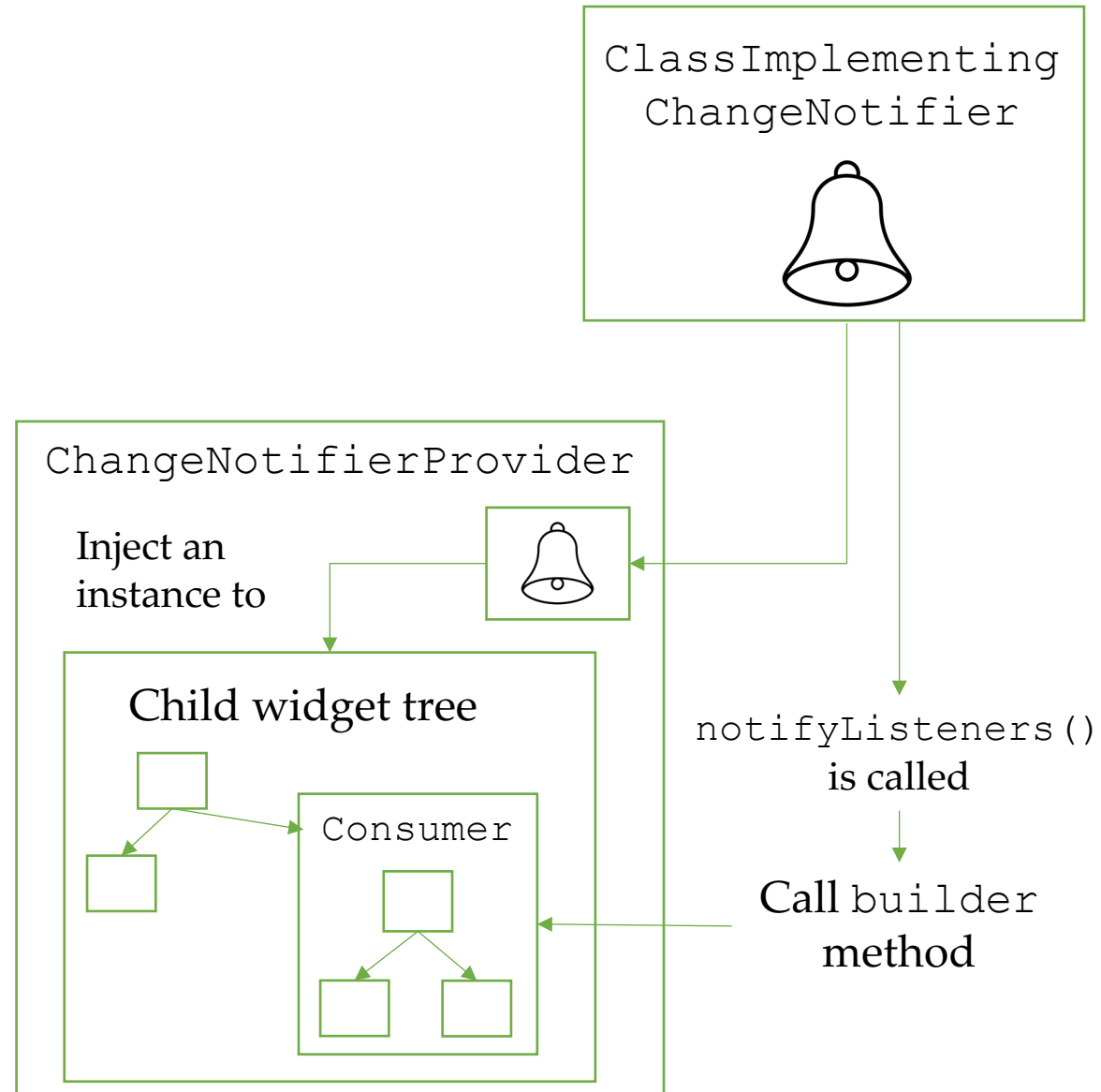
- Consumer is a widget that listens for changes in a class that implements `ChangeListener`, then rebuilds the widget tree below itself when it finds any.

- Whenever `notifyListeners()` is called, the Consumer's builder function is called. Syntax:

```
return
Consumer<ClassImplementingChangeListener>(
  builder: (context, cart, child) {
    return Text("Total price:
      ${cart.totalPrice}");
  },
);
```



Wrapping up: Provider (core) flow



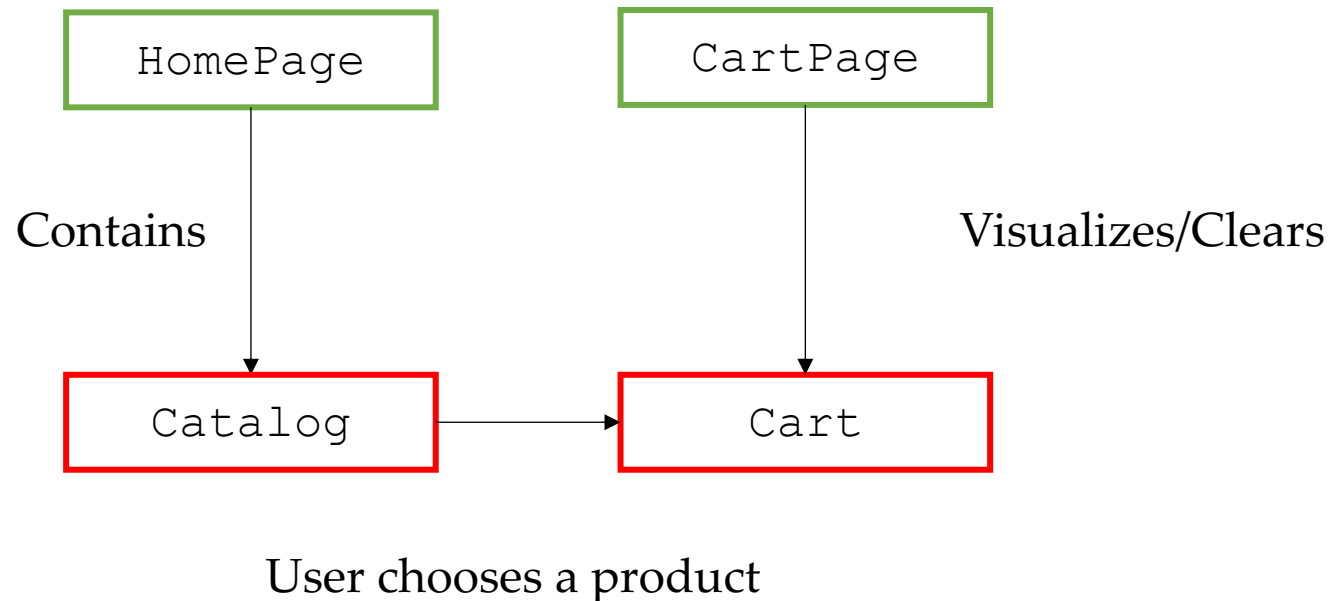
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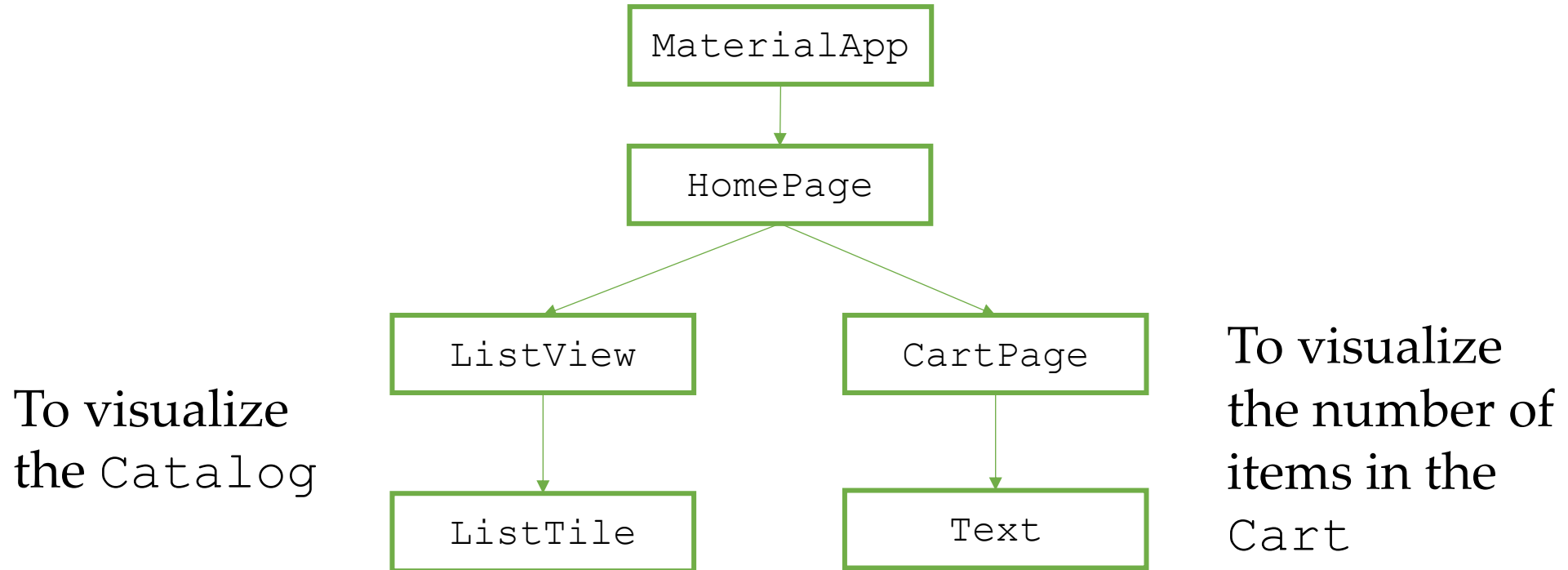
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Case of study

- We will build a (too) simple e-commerce app. Users can choose, in the HomePage, products from a catalog and add them to the cart. In a different screen, CartPage, the number of items in the cart is visualized.



Case of study – UI widget tree



- How to manage the catalog and the cart? With two class (model).
 - No problems with the Catalog (Ephemeral state)...
 - On the other hand, Cart must be shared (App state) Where to put it?

Catalog

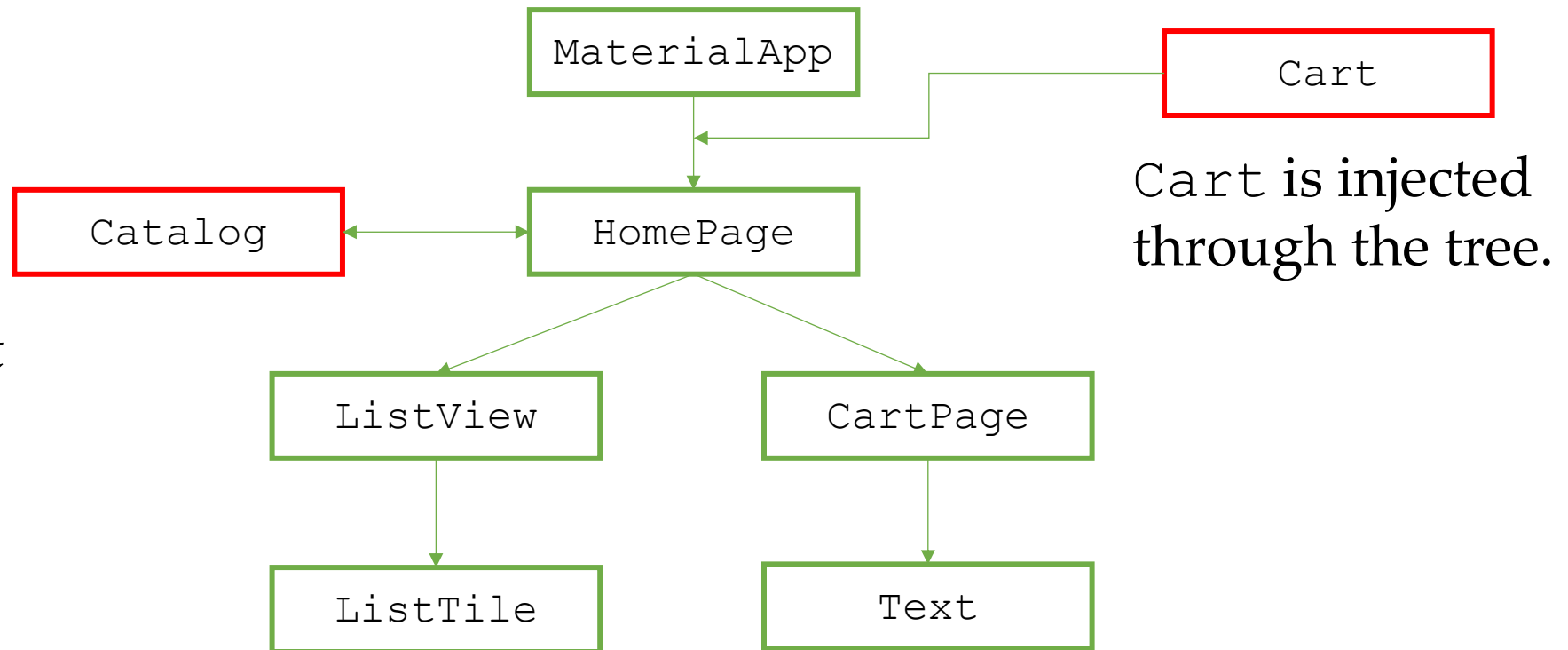
Cart

Lift the state up

- The idea is “Lift the state up”

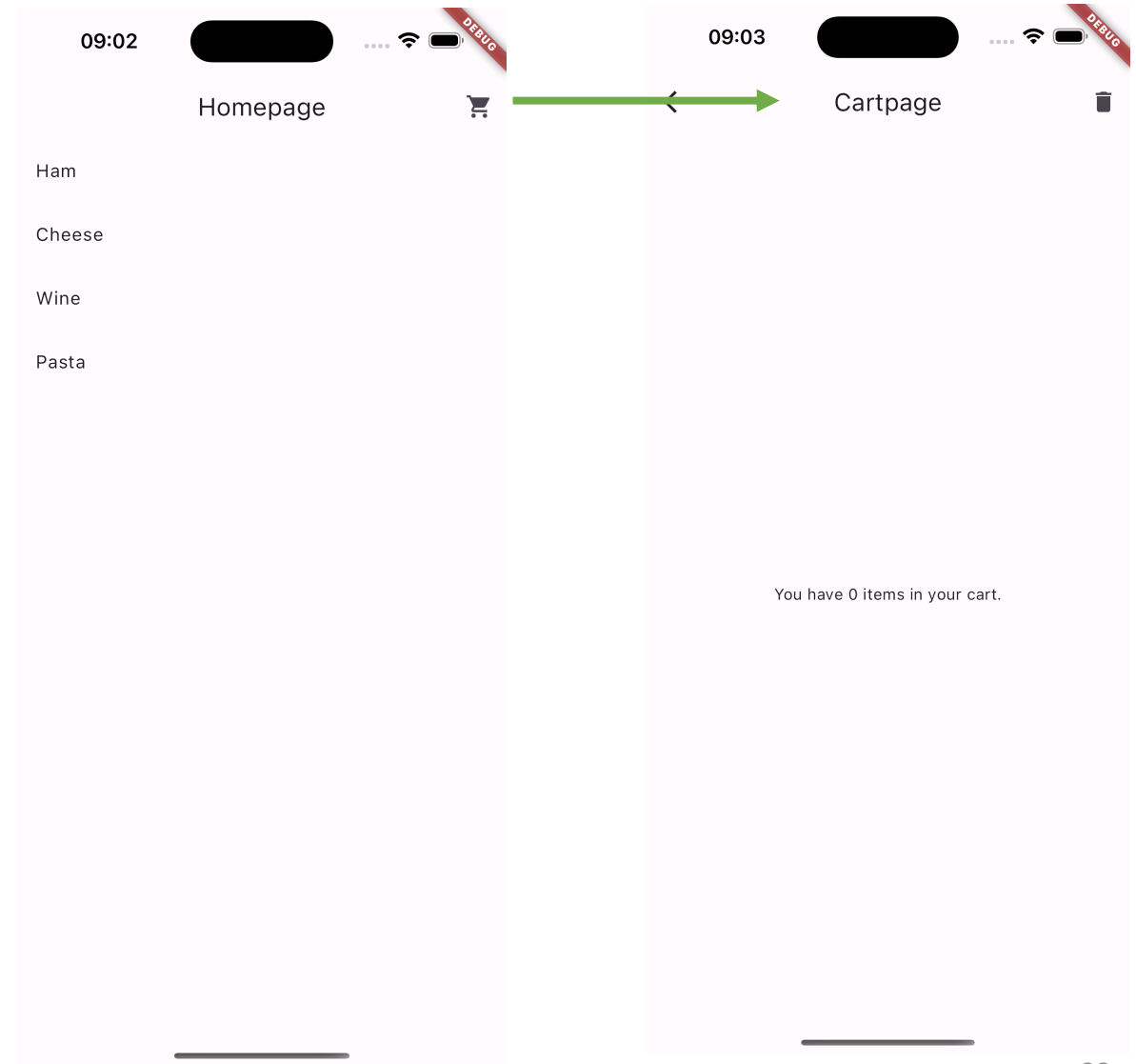
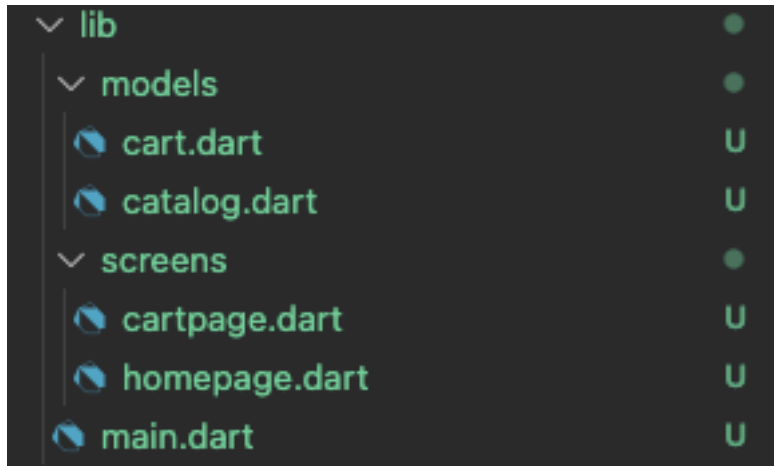
$$\text{UI} = f(\text{state})$$

The layout on the screen Your build methods The application state



Case of study - Live

- Let's create a new project "shopper" that implements the case of study and shows how to use Provider.



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Provider classes

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- **`FutureProvider/StreamProvider`**
- **`MultiProvider`**
- **`ProxyProvider`**

Provider classes: FutureProvider/StreamProvider

- FutureProvider and StreamProvider are the same thing as ChangeNotifier but they work with Futures and Streams instead of ChangeNotifier.
- Synthax example:

```
FutureProvider(  
  initialData: null,  
  create: (context) => <get_a_future>,  
  child: <widget>,  
);  
StreamProvider(  
  initialData: null,  
  create: (context) => <get_a_stream>,  
  child: <widget>,  
);
```

initialData is used
as value while the
Future is loading.

create specifies the
Future object.

Provider classes: MultiProvider

- What if you need to inject more than one provider through the widget tree? Use `MultiProvider`.
- Synthax example:

```
MultiProvider(  
  providers: [  
    ChangeNotifierProvider(...),  
    FutureProvider(...),  
  ],  
  child: <widget_tree>,  
);
```

List of providers.



Provider classes: ProxyProvider

- What if you have two models that you want to provide, but one of the models depends on the other one? In that case you can use a ProxyProvider.
- A ProxyProvider takes the value from one provider and lets it be injected into another provider.
- Synthax example:

```
MultiProvider(  
  providers: [  
    ChangeNotifierProvider<MyModel>(  
      create: (context) => MyModel(),  
    ),  
    ProxyProvider<MyModel, AnotherModel>(  
      update: (context, myModel, anotherModel) =>  
        AnotherModel(myModel),  
    ),  
  ],  
)
```

Provider classes – Much more

- Of course, the Provider package can do much more
 - `ListenableProvider`
 - `ValueListenableProvider`
 - `ChangeNotifierProxyProvider`
 - `Selector`
 - ...
- To learn more, take a look at this useful article:
 - Making sense of all those Flutter Providers
 - <https://medium.com/flutter-community/making-sense-all-of-those-flutter-providers-e842e18f45dd>

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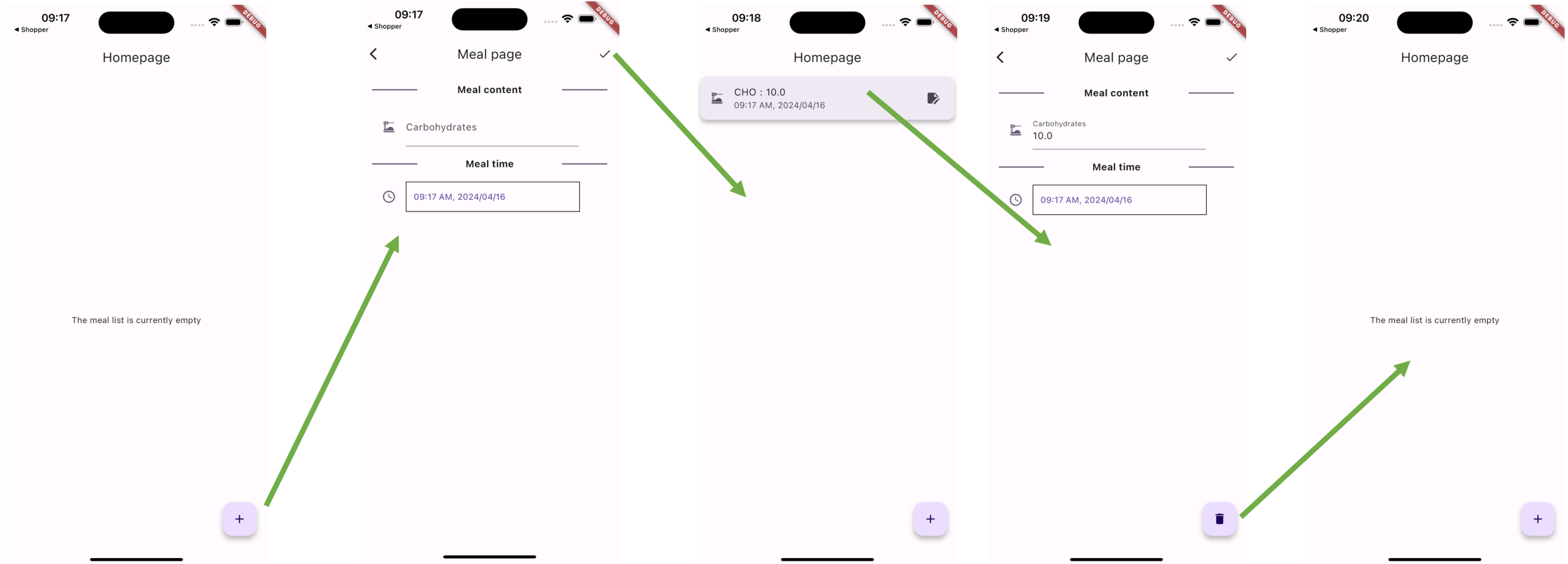
- **Exercise**
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Exercise

➤ Exercise 07.01

- Create a new project 'meal_manager', an app that stores the meal intakes of a user in terms of carbohydrate content and meal timing.
- The app needs to implement the following functionalities:
 - When a user opens (or restarts) the app, an empty list is showed;
 - By tapping a button, the user navigates to another page where he can add a new meal (CHO content and timing). Once he/she is done, the user taps a button and navigates back to the home page. The home page must show the updated meal list with the new meal just created;
 - The user can select a meal from the list. If he/she does that, he/she navigates to another page where he/she can edit or delete the meal entry from the list.

Exercise: here's a possible idea



Homepage is initially empty

When the button is tapped the user navigates to another page where he/she can add a new meal

When the user finishes, the new meal is added to the list

When the meal is tapped, the user navigates to a new screen where he/she can edit or delete it

If the meal is edited/deleted the list is updated.

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Homework

- Get familiar with Provider
- Take a look to other approaches, e.g., Riverpod or BLoC. Maybe there is something that fits better your way of thinking!
- Take a look at my solution. You will find some useful code.

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Resources

- State management
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- Making sense of all those Flutter Providers
 - <https://medium.com/flutter-community/making-sense-all-of-those-flutter-providers-e842e18f45dd>
- List of state management approaches
 - <https://docs.flutter.dev/development/data-and-backend/state-mgmt/options>