ABOUT YOU TECH

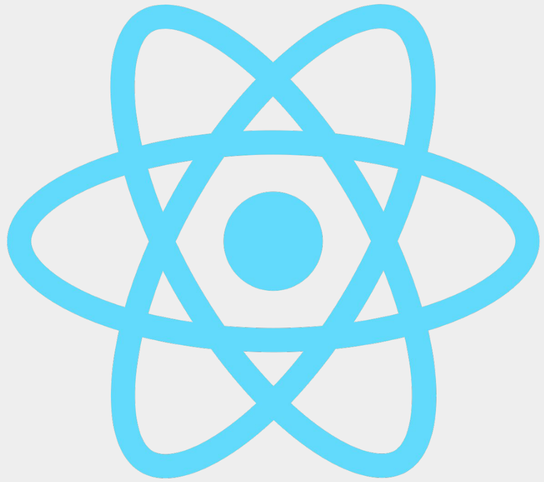
A Very New Way of Developing

TypeScript

Redux

React Native at AY

- Development in 2017
- Powers current App (4.6 Stars)
- TypeScript
- Redux
- Redux Saga (Side Effect management)
- First "modern" stack with Typescript (Anyscript) and React



React Native at AY - The Good

- Staying in the Web Ecosystem
  - Typescript
    - Eased in types into our code base
    - Helped a lot with the growing codebase
  - React
    - Components
    - Easier Lifecycles
  - Prettier / tslint
    - Takes Care of formatting
- Fast Development Cycles at the beginning

1. **Developer Experience**

   Debug Mode and Hot Reload, State Management, Upgrades

2. **Performance**

   Rerenders and the JS Bridge

3. **Rewrite vs. Refactoring**

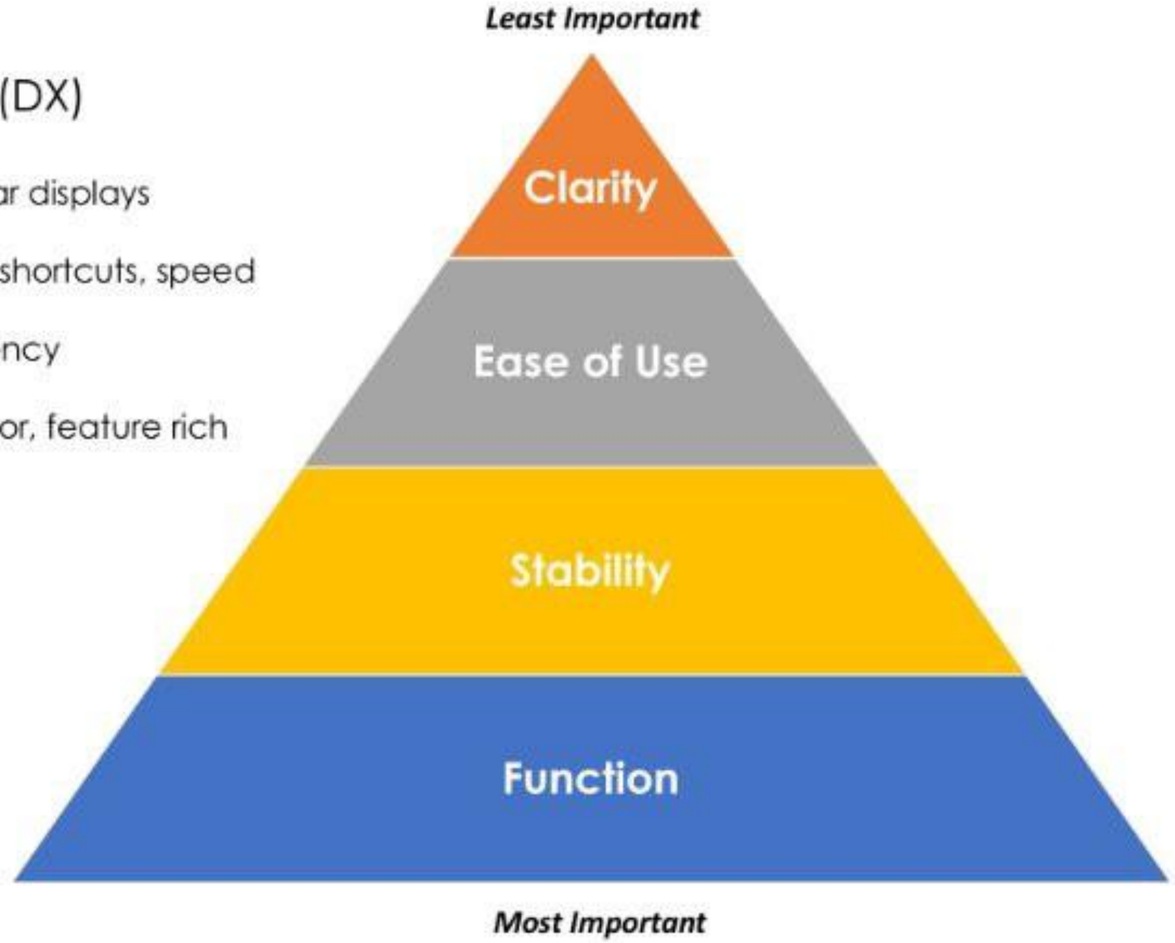
   Taking the Leap

4. **What makes Flutter different?**

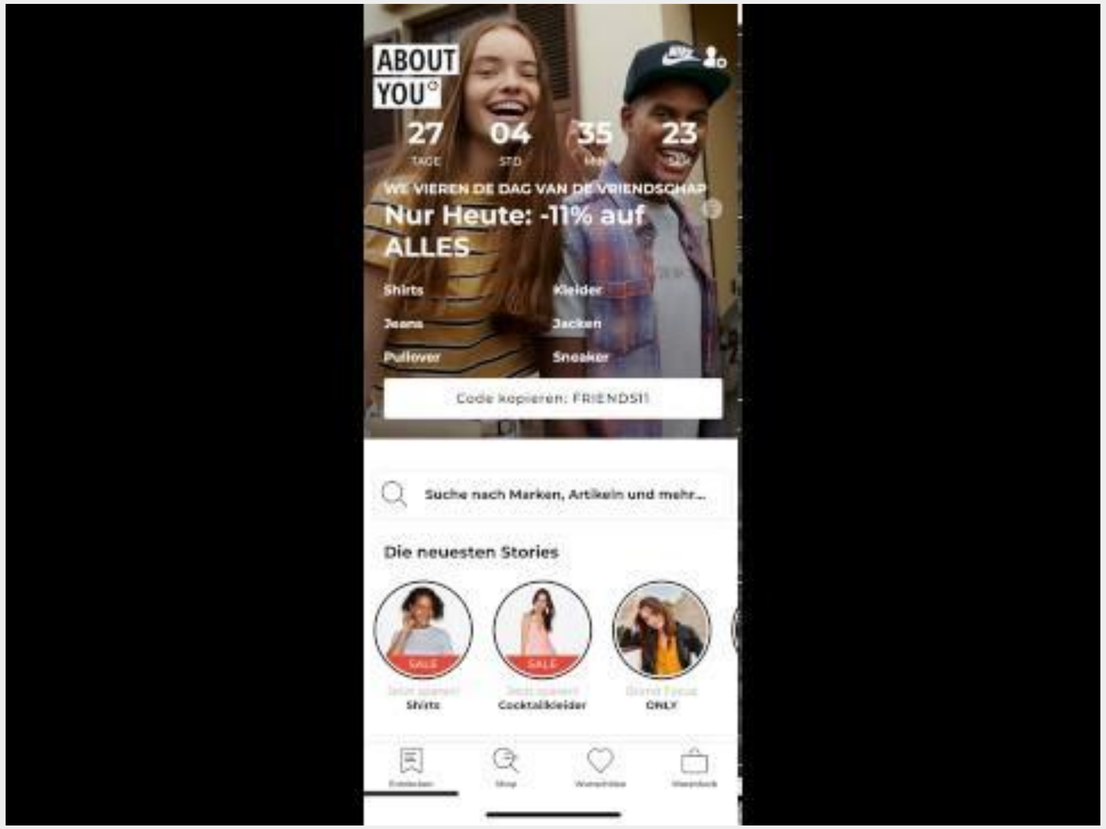
   Developer Experience and Performance

Developer Experience (DX)

- Clarity – Intuitive visuals, clear displays
- Ease of Use – Quick access, shortcuts, speed
- Stability – Reliability, consistency
- Function – Expected behavior, feature rich

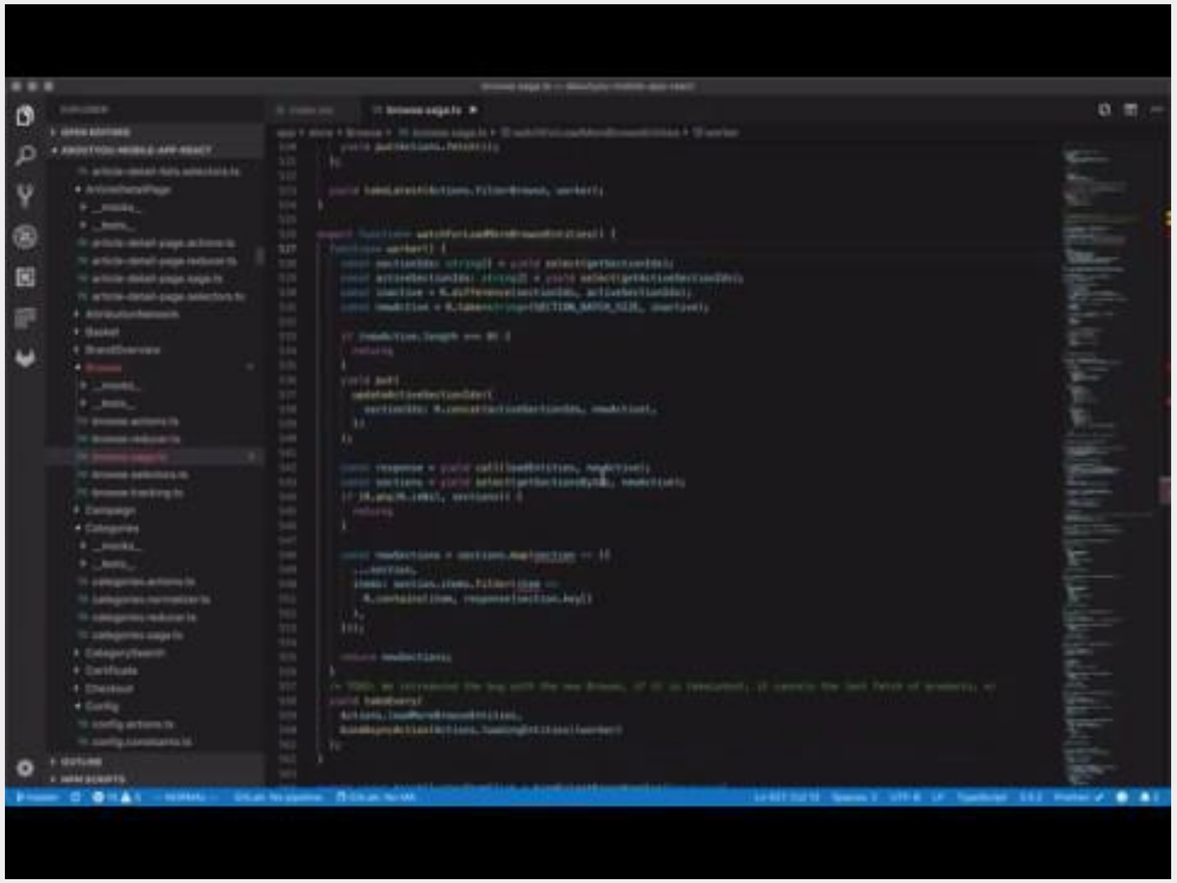


Justin Baker 2016



Debug Mode and Hot Reload

- Really good for smaller project
- Started to get painfully slow as the project grew
- Hot Reload started to reset state (react-native-navigation)
- Webpack performance degrades over time
- Breakpoints not working most of the time
- Developers need to wait up to 10 minutes for their build to test



State Management - Code Navigation

- Too much reliance on the global state
  - Every action is handled via sagas
  - Almost no local component state
- Tons and Tons of boilerplate
- Too much complexity which makes for a rough onboarding

```
526  export function* watchForLoadMoreBrowseEntities() {
527    function* worker() {
528      const sectionIds: string[] = yield select(getSectionIds);
529      const activeSectionIds: string[] = yield select(getActiveSectionIds);
530      const inactive = R.difference(sectionIds, activeSectionIds);
531      const newActive = R.take<string>(SECTION_BATCH_SIZE, inactive);
532
533      if (newActive.length === 0) {
534        return;
535      }
536      yield put(
537        updateActiveSectionIds({
538          se
539        })
540      );
541
542      const response = yield call(loadEntities, newActive);
543      const sections = yield select(getSectionsByIds, newActive);
544      if (R.any(R.isNil, sections)) {
545        return;
546      }
547
548      const newSections = sections.map(section => ({
549        ...section,
550        items: section.items.filter(item =>
551          R.contains(item, response[section.key])
552        ),
553      }));
554
```

```
const response = yield call(loadEntities, newActive);
const sections = yield select(getSectionsByIds, newActive);

const response: any
```

State Management

- Didn’t take into account redux-saga type safety in the beginning (Anyscript)
- Types are lost in Redux-Sagas generators
- Went as far as developing tsaga, which is a typed alternative

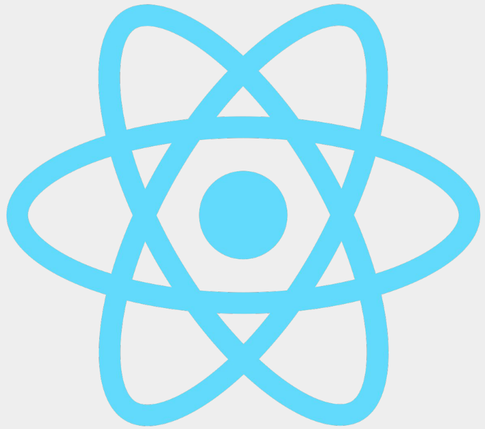
Upgrading React Native and packages

- Third party packages frequently break
- Build system frequently broke especially in the beginning
  - Metro Bundler Upgrade
- Same Issues as bigger web projects with the added complexity of native dependencies

Performance

- App Startup Time
  - Up to 15 seconds on older Android devices
  - Almost 3-5 seconds on newer devices

- We had to be very careful with rerenders



All of these Issues are fixable, but...

Slow Development of React Native, loss of confidence

-

Android Performance issues were just addressed recently (Hermes VM)

-

Promises of 20% performance improvement, we wanted more

-

Big new features and a revamp of the shop were planned

Adoption of Material UI for our designs

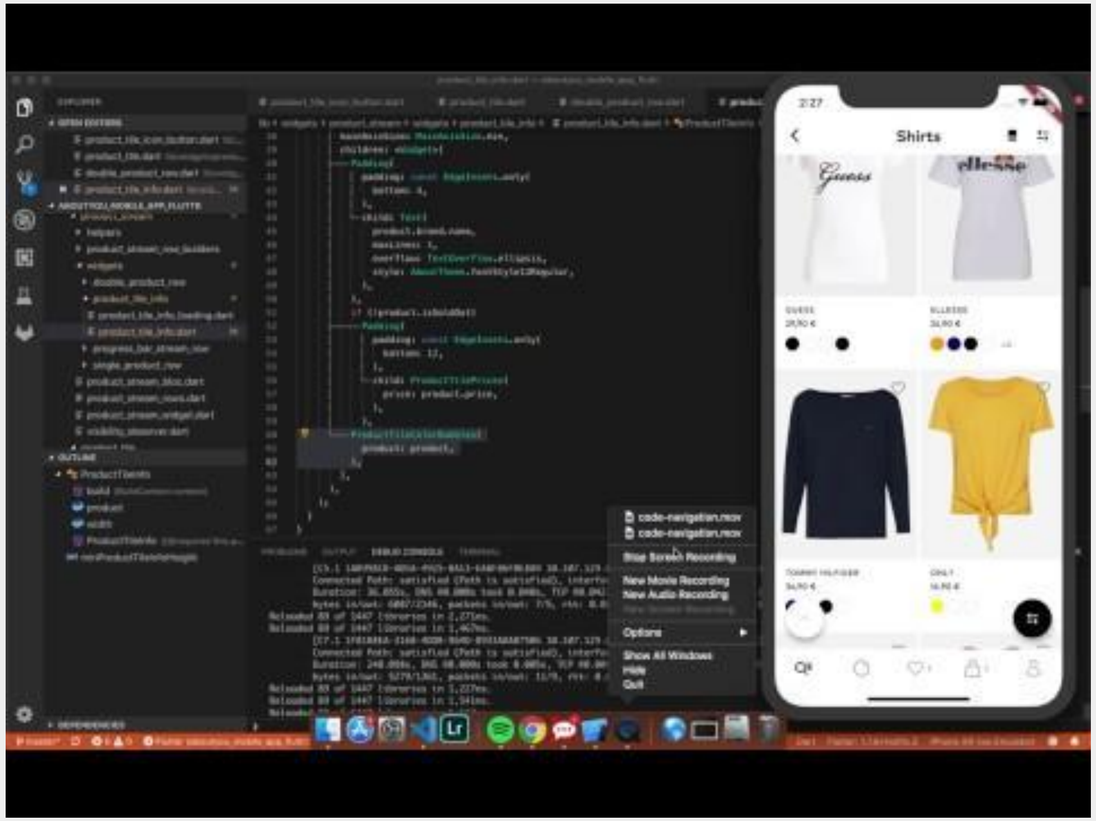
Evaluation Phase - Key Questions

- Decision to definitely use it for prototyping
- Better Performance and Developer Experience?
- Can we find an easier state management pattern?
- Do Tracking and Native Packages support that we need?
- Can we migrate our users?
- Can we “fix” tracking?

Approaching the Rewrite - Commitments

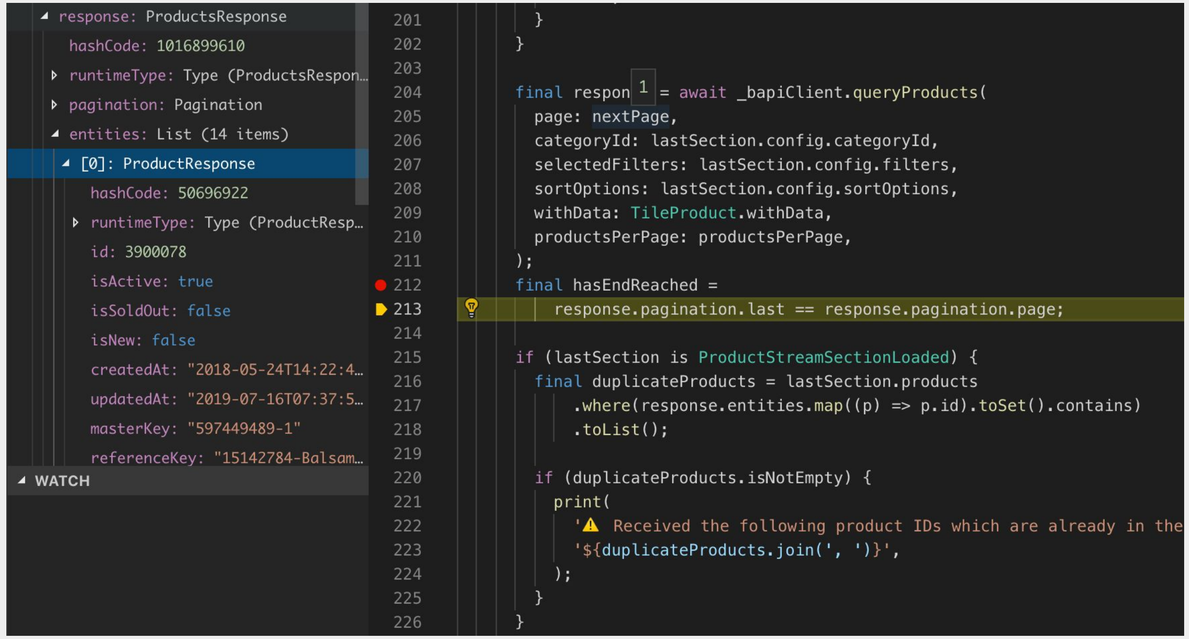
- Keep things simple
- Drop Features that are complex but not used frequently
- Keep State more local
- Make Code Easy to Navigate

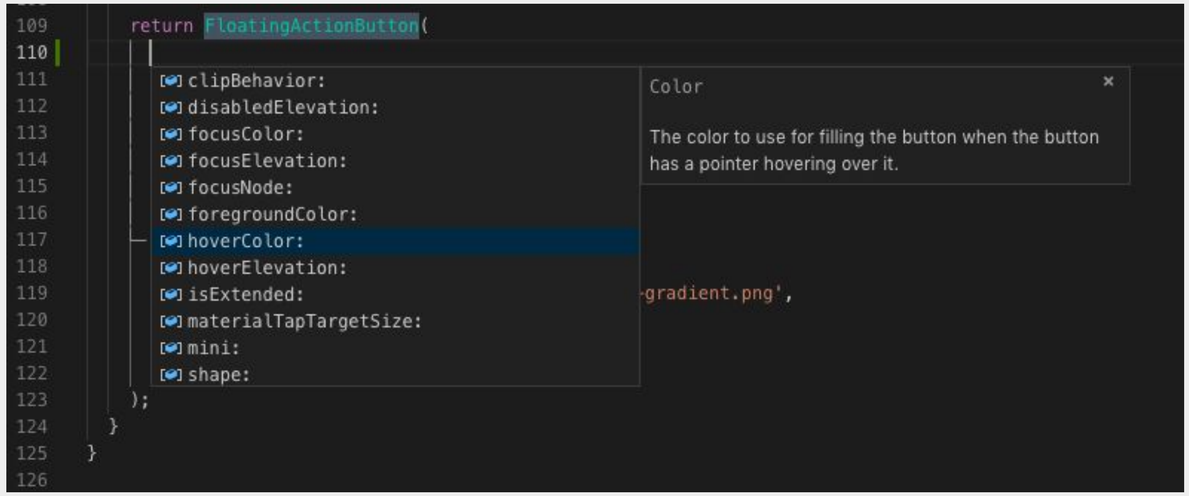
Why Flutter?



Developer Experience

- Very fast Hot Reload that keeps the State
- Dart supports AOT and JIT compilation
- Dart Developer Tools rapidly improving
- Almost no need to doublecheck on the device (except for notches)





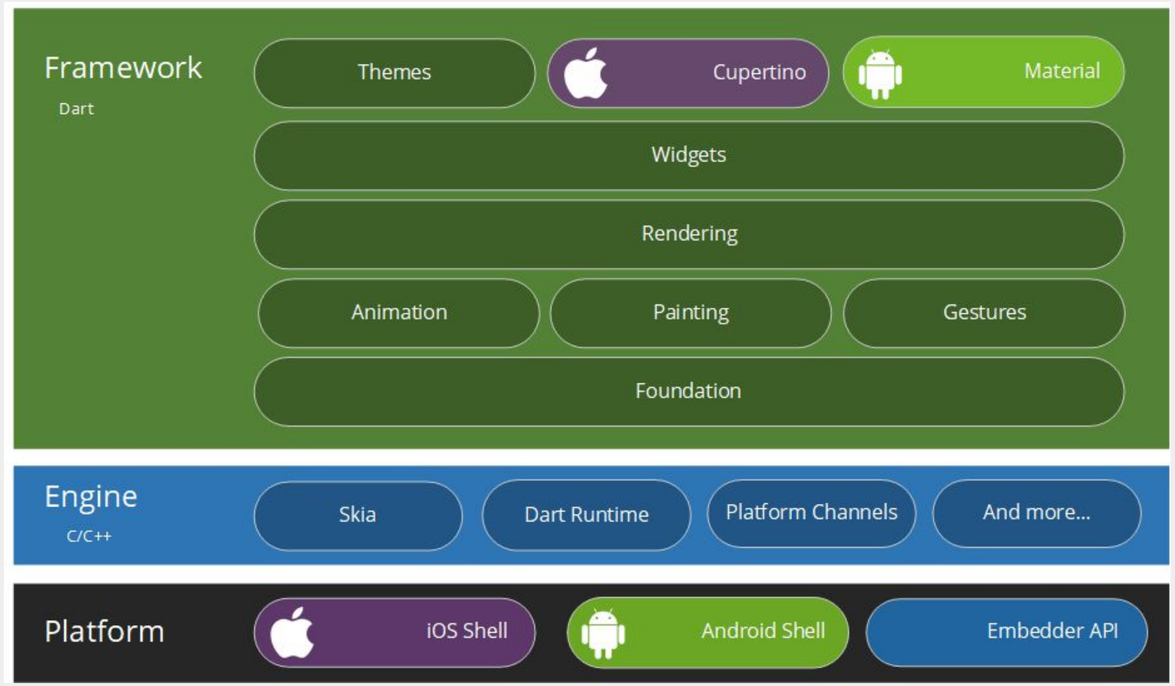
Developer Experience

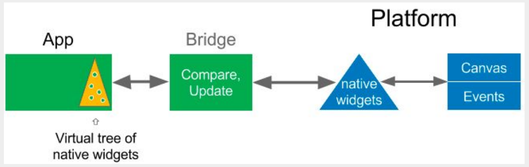
- Dart very easy to adapt with previous TypeScript experience (async, await etc.)
- Breakpoints
- Dart Developer Tools rapidly improving
- Great in Code Documentation of every Flutter Widget and core functions
- Almost no need to double check on the device (except for notches)


```
CustomScrollView(
    slivers: <Widget>[
      SliverAppBar(
        title: Text('SliverAppBar'),
        backgroundColor: Colors.green,
        expandedHeight: 200.0,
        flexibleSpace: FlexibleSpaceBar(
          background: Image.asset(
              'assets/forest.jpg',
              fit: BoxFit.cover,
          ),
        ),
      ),
      SliverFixedExtentList(
        itemExtent: 150.0,
        delegate: SliverChildListDelegate(
          [
            Container(color: Colors.red),
            Container(color: Colors.purple),
            Container(color: Colors.green),
            Container(color: Colors.orange),
            Container(color: Colors.yellow),
            Container(color: Colors.pink),
          ],
        ),
      ),
    ],
);
```

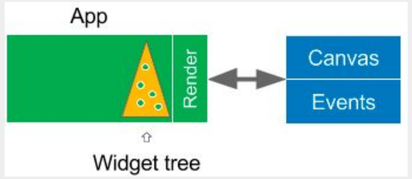
Developer Experience - Material UI and Widgets

- Everything is a widget
- Material UI Elements “Out of the Box”
  - AppBar
  - FloatingActionButton
  - …
- Widgets are highly optimized for the use case
  - Padding
  - Column / Row widgets
  - RotatedBox
  - ListViews
  - Text
  - …
- A lot of Requirements are just very easy to cover



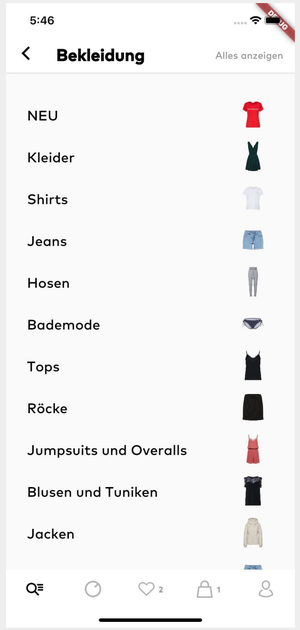


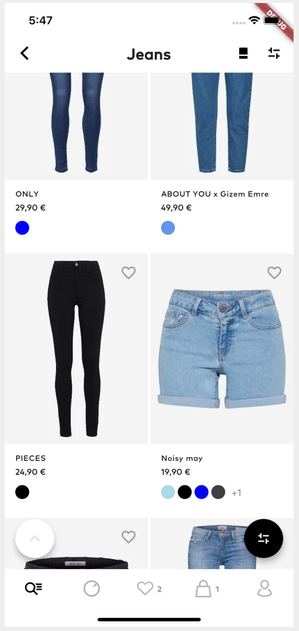
vs.

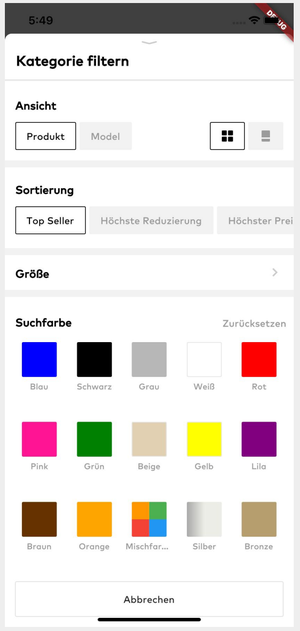


Performance

- Dart is compiled down to native code
- Almost instant startup time
- No Slow Bridge
- No difference between newer iOS and Android devices
- Good performance even on old Android device







After 3 Months, so far:

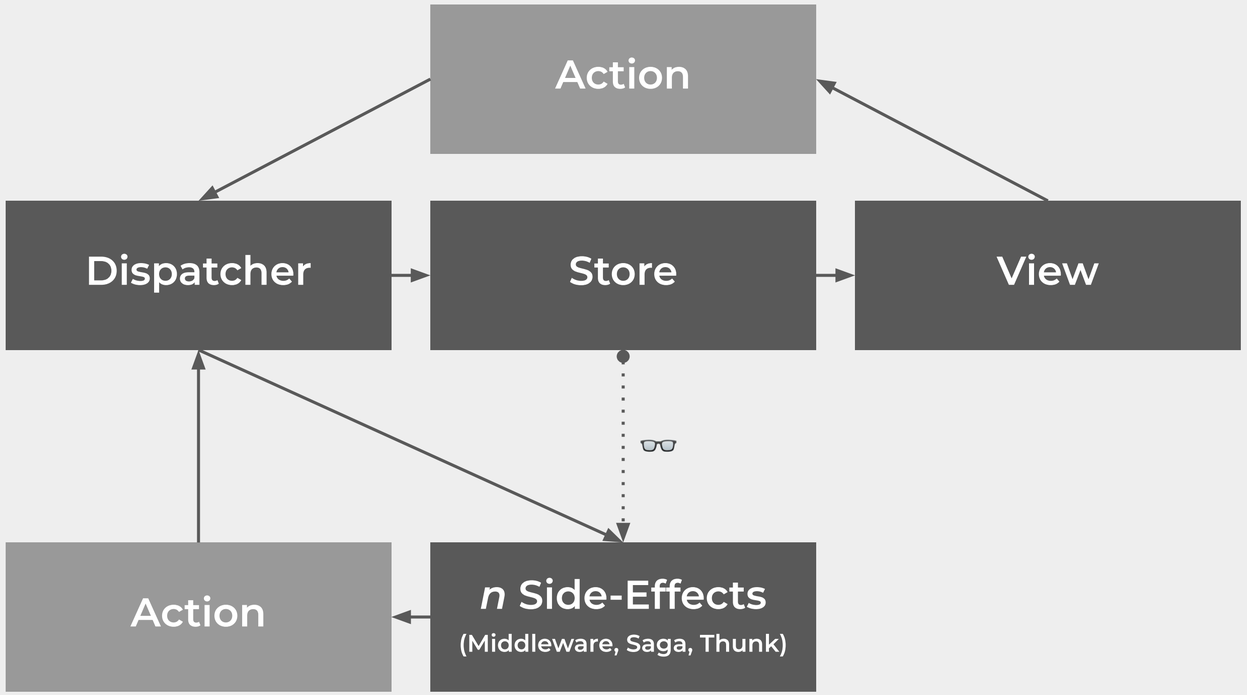
Developers are happy

Improved Iteration Speed

Golden File Tests still a little flaky

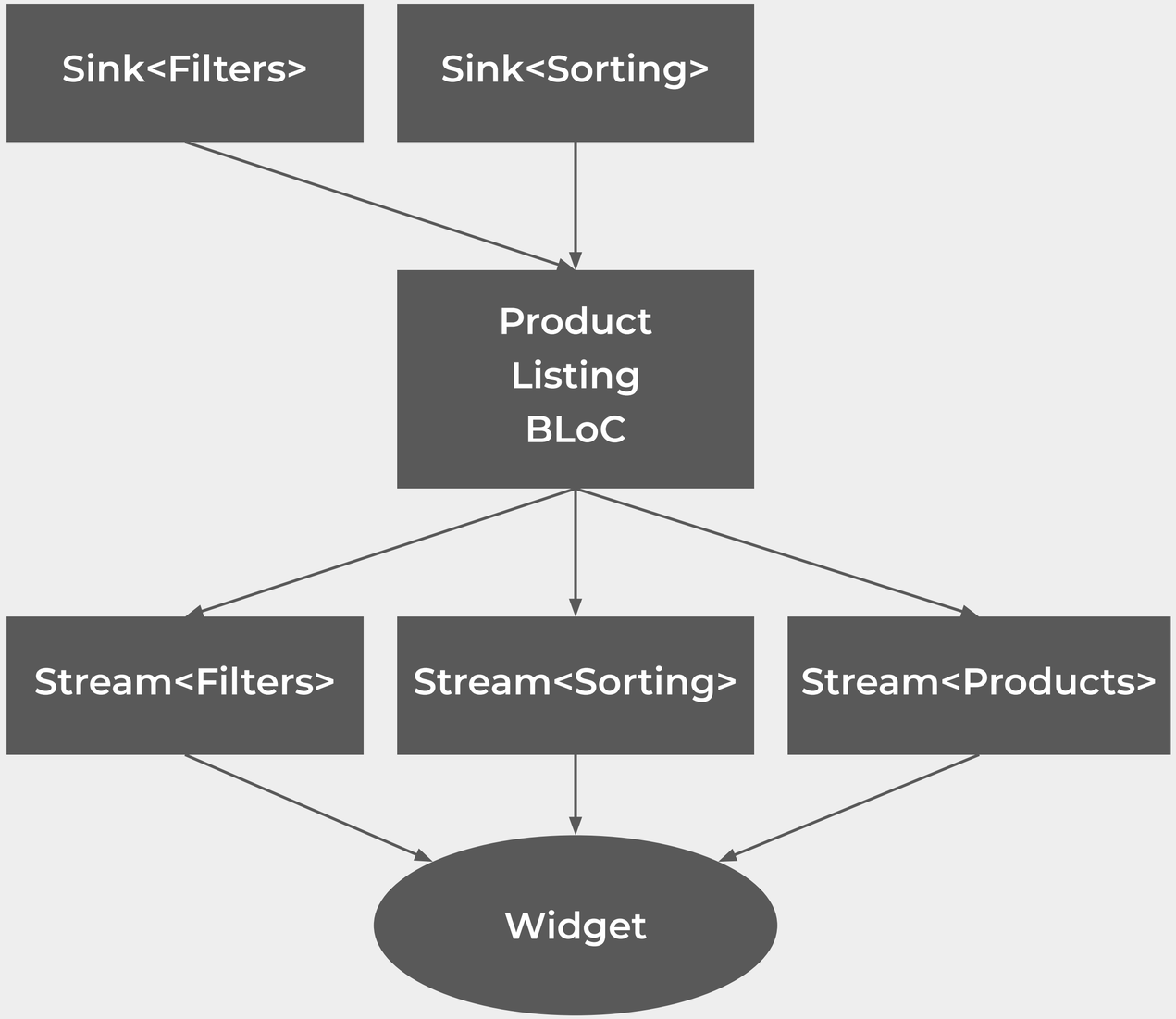
Writing asserts is annoying

Timm says: "It's a lot less stupid than what we've used before"



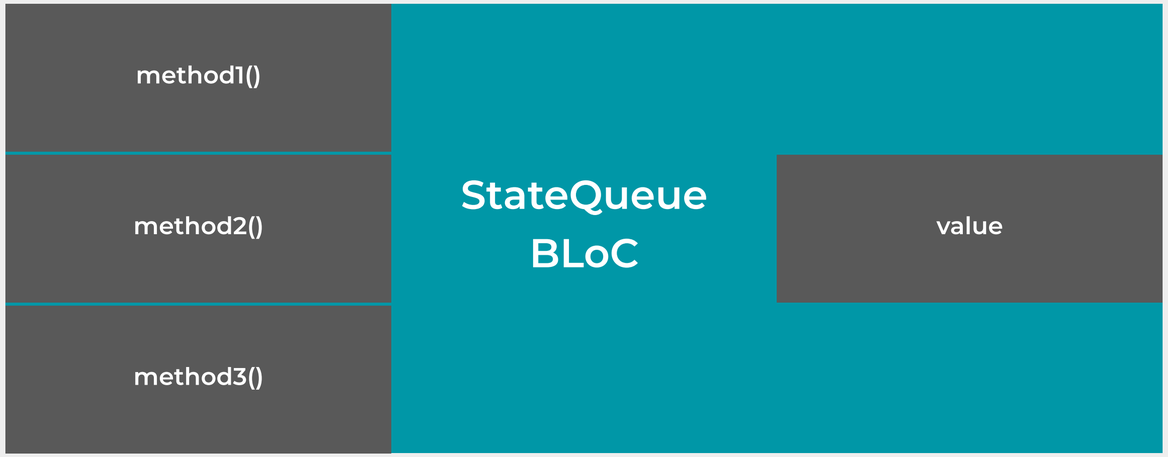
Redux Recap

- 1 Global Dispatcher, 1 Global State
- Simple in theory, not so much in our reality



BLoC (Business Logic Component)

- Sinks as Inputs
- Streams as Outputs
- Popular in the Flutter ecosystem due to being shown by Google



Our current setup

- ValueNotifier
- Provider
- StateQueue
- WithBloc
- HTTP Caching (WIP)

```dart
/// A [ChangeNotifier] that holds a single value.
///
/// When [value] is replaced with something that is not equal to the old
/// value as evaluated by the equality operator ==, this class notifies its
/// listeners.
```

Michael Goderbauer, 3 months ago | 5 authors (Adam Barth and others)

```dart
class ValueNotifier<T> extends ChangeNotifier implements ValueListenable<T> {
  /// Creates a [ChangeNotifier] that wraps this value.
  ValueNotifier(this._value);

  /// The current value stored in this notifier.
  ///
  /// When the value is replaced with something that is not equal to the old
  /// value as evaluated by the equality operator ==, this class notifies its
  /// listeners.
  @override
  T get value => _value;
  T _value;
  set value(T newValue) {
    if (_value == newValue)
      return;
    _value = newValue;
    notifyListeners();
  }

  @override
  String toString() => '${describeIdentity(this)}($value)';
}
```

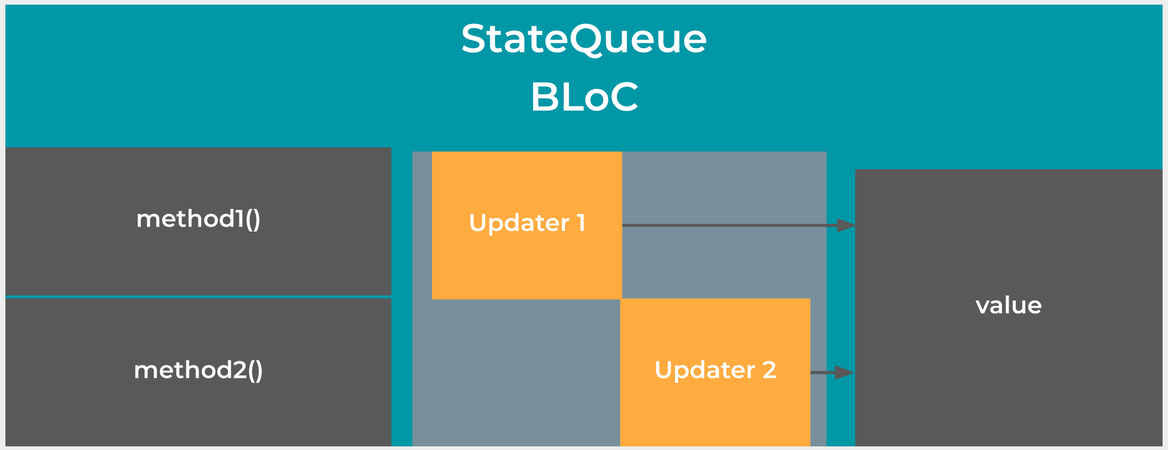
ValueNotifier

- ValueListenable (interface)
  - Holds a value of type *T*
  - Exposes listener registration
- ChangeNotifier (class)
  - Manages listeners
  - Allows subclass to notify listeners
- ValueNotifier implements ValueListenable using ChangeNotifier

```dart
class AppRoot extends StatelessWidget {
  @override
  Widget build(BuildContext context) {
    return ChangeNotifierProvider<BasketBloc>(
      builder: (_) => BasketBloc(),
      child: MainNavigation(),
    ); // ChangeNotifierProvider
  }
}

// [...]

class BasketIcon extends StatelessWidget {
  @override
  Widget build(BuildContext context) {
    final basketState = Provider.of<BasketBloc>(context).value;

    return Row(
      mainAxisAlignment: MainAxisAlignment.center,
      children: <Widget>[
        Icon(
          Icons.shopping_cart,
          color: Colors.black,
        ), // Icon
        SizedBox(width: 5),
        Text(
          '${basketState.productCount}',
        ) // Text
      ], // <Widget>[]
    ); // Row
  }
}
```

Provider

- Dependency Injection
- Implemented as a Widget
- Makes higher-up values available to children “via the context”
- Used to “pass” objects implicitly through many intermediate layers
  - E.g. from global basket BLoC to leaf icon badge



StateQueue

- Implements sequential execution of updaters on top of ValueNotifier
- Simplifies reasoning as it ensures that at most 1 state modification is running at any time
- Uninterruptible updaters can emit multiple states
  - E.g *loading*, then *loaded* state
- Suitable for most of our cases
  - Concurrent states are handled separately

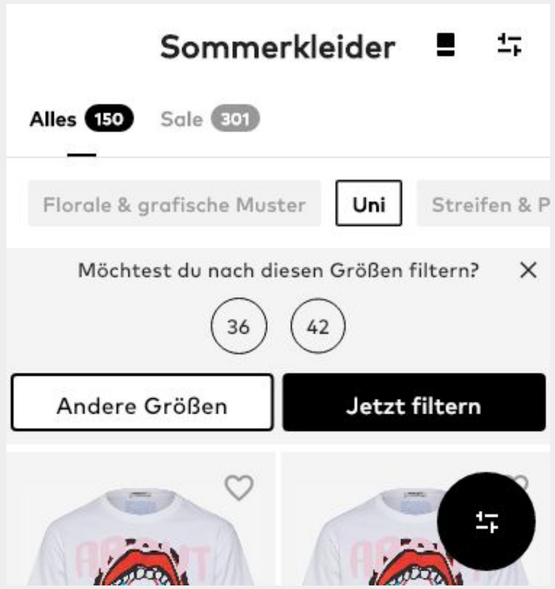
```dart
class BasketBloc extends StateQueue<Basket> {
  BasketBloc() : super(BasketLoading());

  /// Adds the product to the basket or increases its quantity by 1 if it exists
  void addOrUpdateProductInBasket(int productId) {
    run((state) async* {
      yield BasketLoading();

      final existingItem = state.exisitingItem(productId);

      if (existingItem == null) {
        yield await basketWithNewProduct(productId);
      } else {
        yield await basketWithUpdatedQuantities(
          existingItem.key,
          existingItem.quantity + 1,
        );
      }
    });
  }
}
```

StateQueue Demo

```dart
class CounterBloc extends StateQueue<int> {
  CounterBloc() : super(0);

  void increment() {
    run((state) async* {
      yield state + 1;
    });
  }
}

class Counter extends StatelessWidget {
  @override
  Widget build(BuildContext context) {
    return WithBloc<CounterBloc, int>(
      createBloc: (_) => CounterBloc(),
      builder: (context, bloc, state, _) {
        return MaterialButton(
          child: Text('Count = $state'),
          onPressed: bloc.increment,
        ); // MaterialButton
      },
    ); // WithBloc
  }
}
```

WithBloc

- Makes it easy to create local blocs during *build*
- Automatically recreates the BLoC when inputs change
  - Simpler than manual tracking in lifecycle methods
- Disposes the BLoC once the widget unmounts

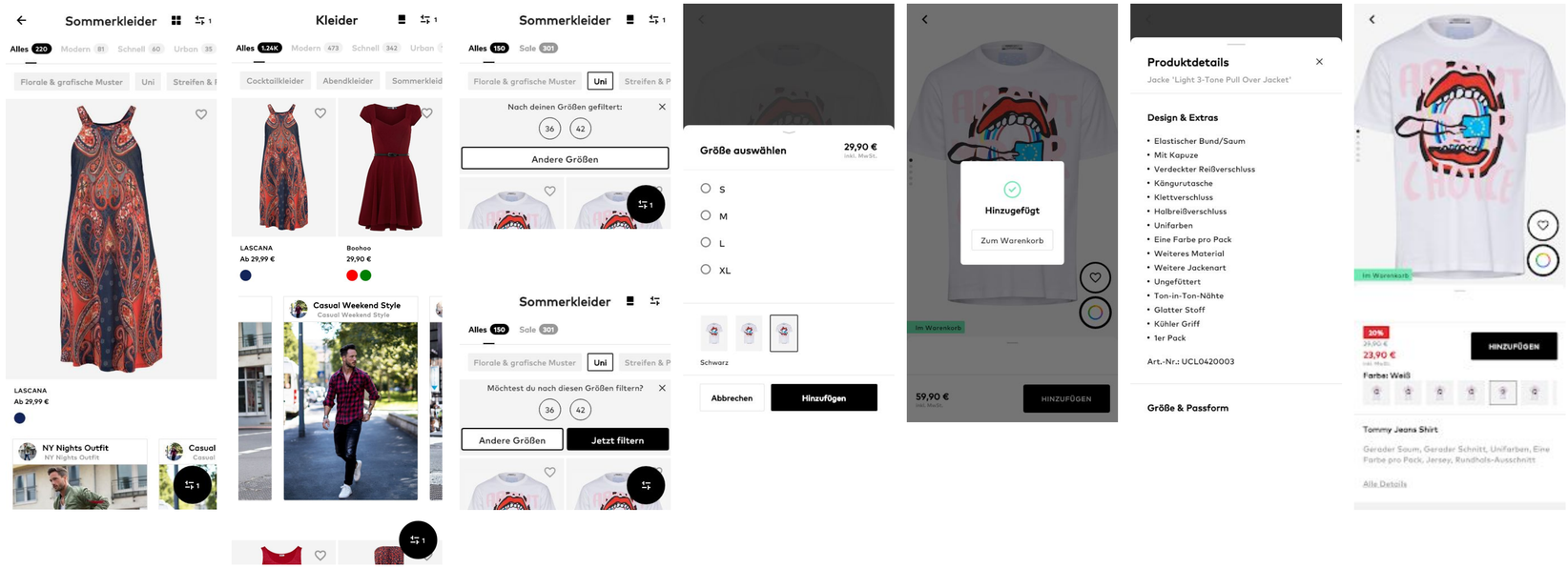


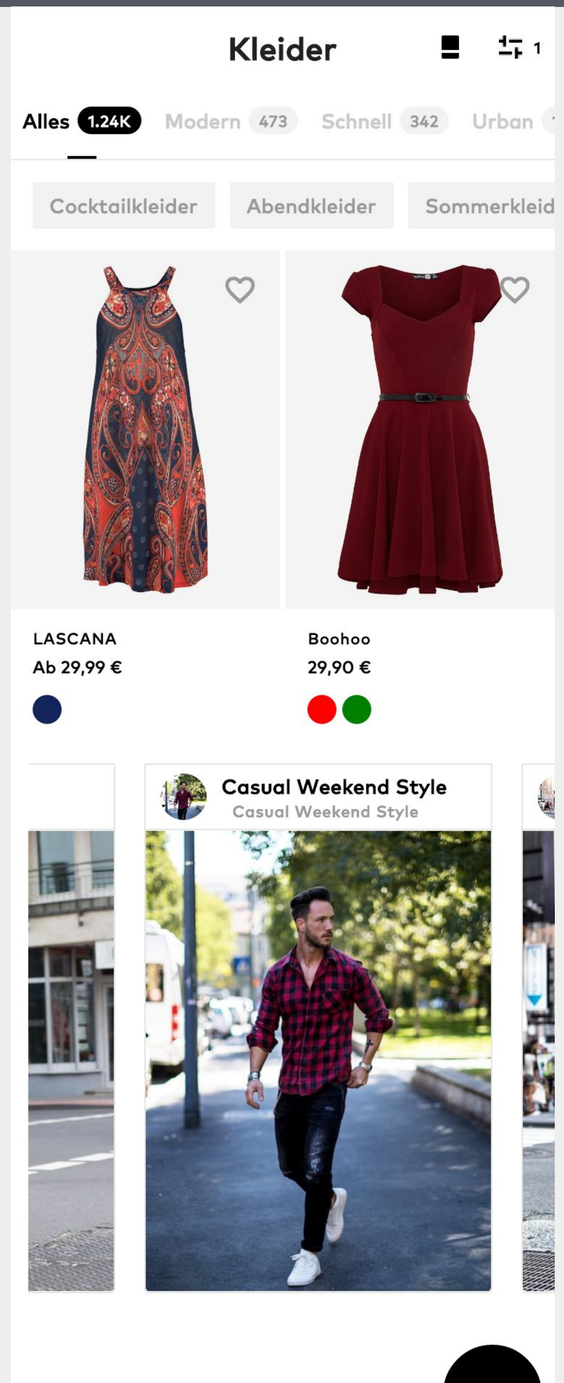
HTTP Caching (WIP)

- Due to the decentralized nature of our state, the same requests happen in multiple places
- Sometimes even at nearly the same time
- Avoids having to align state placement with UI behavior
  - E.g. efficient scrolling lists, which discard hidden widgets
- We found it simpler to handle deduplication on this layer than to connect all those BLoCs to share data
- Today this is also commonly abstracted in GraphQL and similar technologies

Keeping It Simple

- BLoCs have a single, atomic state to the outside
- Concurrency not an issue as it’s not possible
- Avoiding one-off problems where possible
  - E.g. some changes trigger a “restart” (sub second) of the app instead of trying to notify and update all states
- Blocs are either global (shared using Provider), or local and then passed as parameters
- Implementations are explicit
  - go to definition works





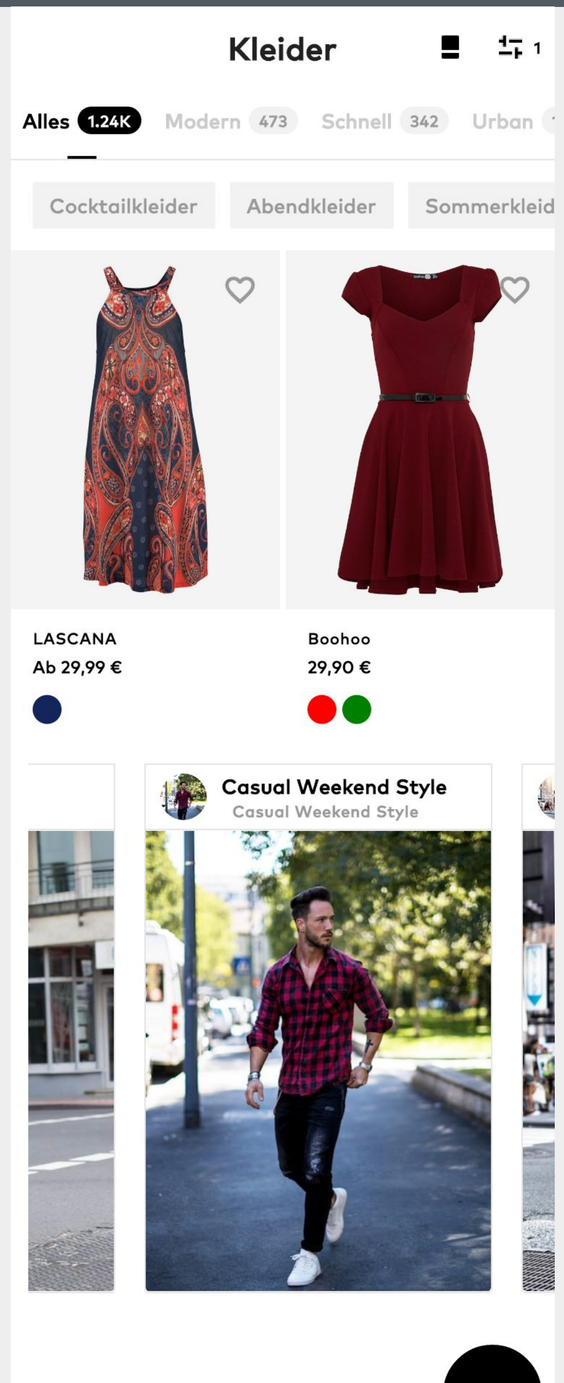
Our current approach

- Test higher-level widgets
  - Usually full pages
  - Sometimes even including navigation to another page
- Use few mocks
  - Test all involved app code
- Build up state / data from captured requests / responses
  - Saved on disk during “record mode”
  - Provided by an alternate HTTP client implementation used in BLoCs

```dart
import 'package:flutter/material.dart';
import 'package:flutter_test/flutter_test.dart';

import 'pages/article-detail-page-widget/article_detail_page_loader.dart';
import 'pages/page_test_utils.dart';

Future<void> main() async {
  testWidgets('Renders ADP', (tester) async {
    await tester.runAsync(
      () async {
        final testSetup = await wrapInMockedProviders(
          ArticleDetailPageLoader(
            productId: 123456,
            pageSource: DeeplinkPageSource(),
          ), // ArticleDetailPageLoader
          lastSeenProducts: [4072105, 3938478],
          mocksPath: './pages/adp/api-mocks/product-1',
        );

        await tester.pumpWidget(testSetup.widget);

        await testSetup.pumpAndSettleIncludingHttpCalls(tester);

        await expectLater(
          find.byType(MaterialApp),
          matchesGoldenFile(
            'goldens/article_detail_page_widget_test_product1.png',
          ),
        );

        expect(testSetup.deleteUnusedRequestsFromDisk(), 0);
      },
    );
  });
}
```

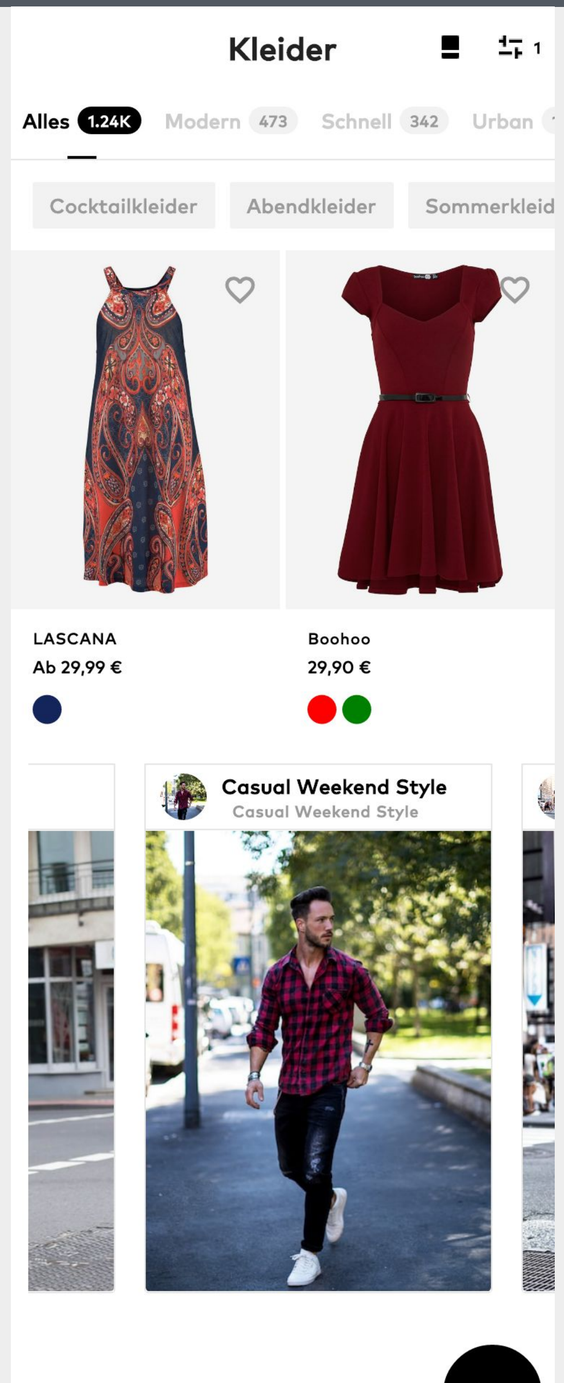
How it works

- testWidgets
  - Runs a headless version of the engine
    - No simulator or devices needed
- pump
  - Resolves pending Futures
  - Ability to advance the clock to control animations
- Custom HTTP Client using JSON API Provider
- Mocks (using Mockito)
- Ability to trigger user input like taps and drags
- GitLab CI + MacPro build server



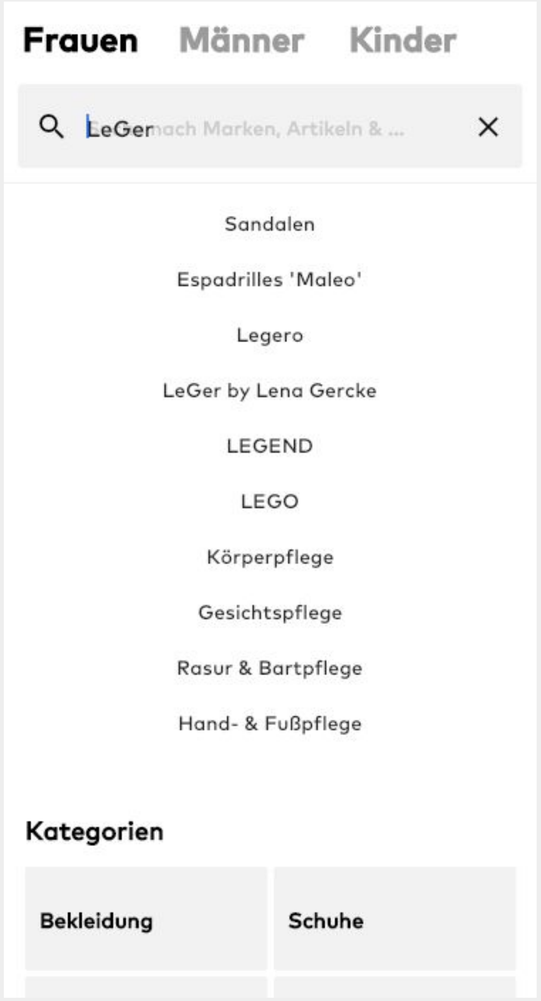
Benefits of our current approach

- We catch regressions (immediately and in CR)
- Full integration tests
  - Feels like a good primary test level
- Visual results
  - Much nicer than HTML snapshots
- Shared widgets are shown in many different context
- Self-contained due to captured responses
  - Not dependent on 3rd party system at test time
- Fast feedback on UI changes (~3 minutes for whole suite)
  - No simulator or devices required



Downsides of our current approach

- Testing variations of scenarios results in duplication of test code and data
  - Only a few very specific things might change between variants, while most of the page stays the same
- Screenshots alone often don't tell what to focus on
  - People approve when it looks good, but might miss what's important
- Some widgets are tested many times without significant changes
  - E.g. header bars
- Using real API responses
  - Schema updates of popular APIs lead to changes in many test cases
  - Response data changes over time (e.g. campaign status)
  - Some API calls are not to be repeated



General sources of flakiness

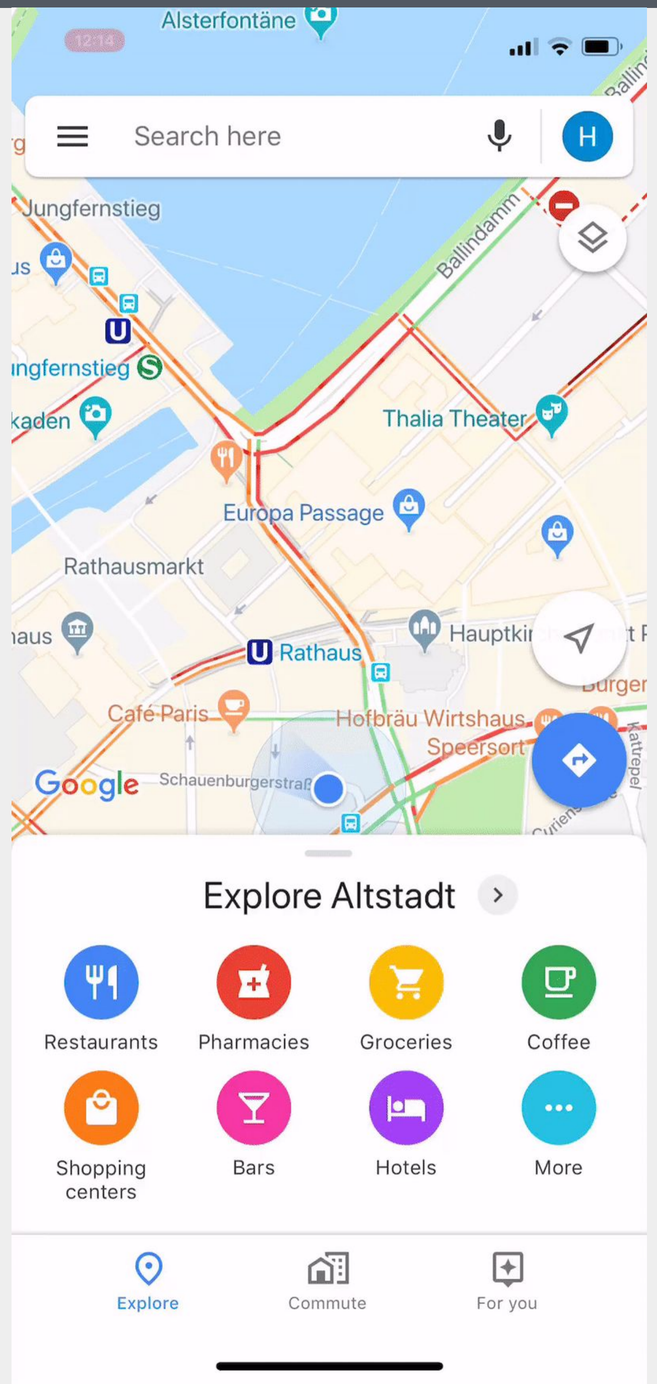
- Sometimes the rendering is unpredictable due to our approach to loading the data via HTTP responses
  - Amount of *pump*s depends on the amount of HTTP responses
  - For legacy reasons we currently advance the clock in each pump
    - Meaning animations move ahead for each response
    - Fix forthcoming

- Examples of UI elements changing with time
  - Scroll bars
  - Blinking cursors
  - Placeholder texts which don't disappear when setting input texts in tests

- Can't yet easily inspect file differences from failures on CI 🧐

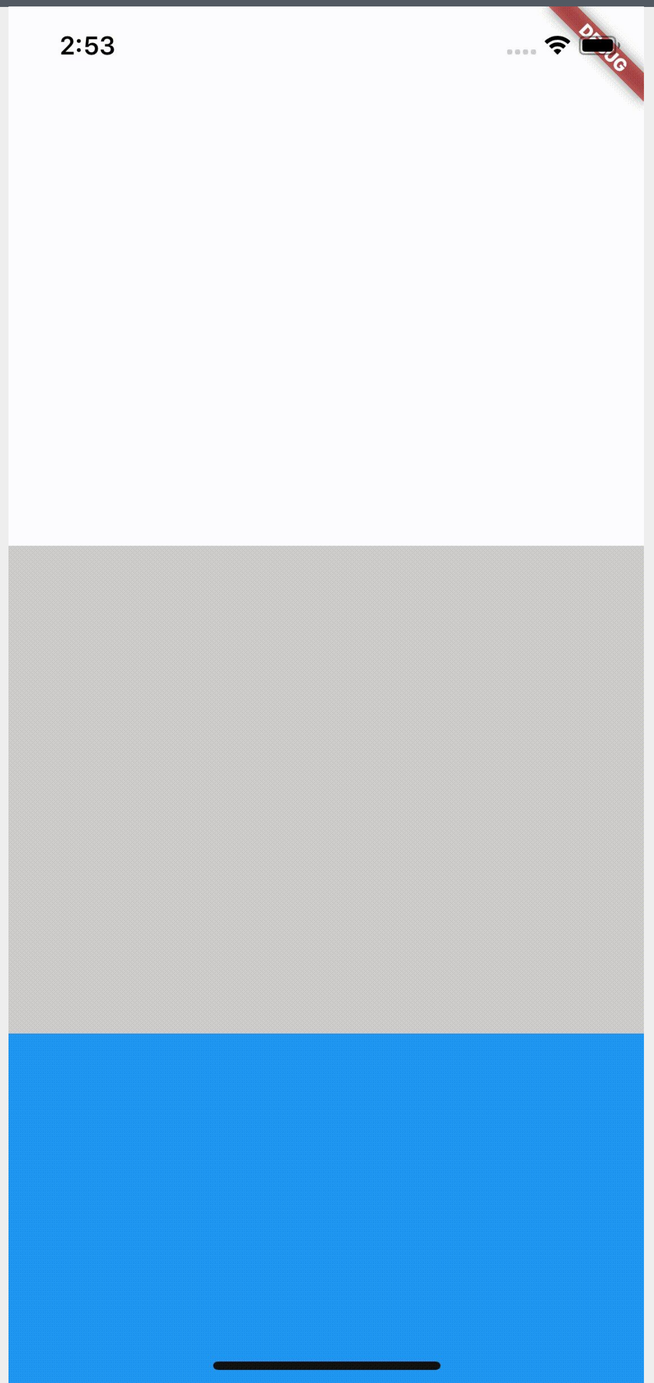
Learnings

- Write more tests
- Do not pack every scenario into an integration test
  - Use individual test for leaf widgets in a certain state
- Provide model mock data to get to specific cases quickly
  - Documents the desired state better than tiny changes in responses
- Use assertions in addition to the final screenshot
  - Point to what's important
- Testing complex user interactions is possible
- Constantly keep improving our tooling
  - It's worth the investment



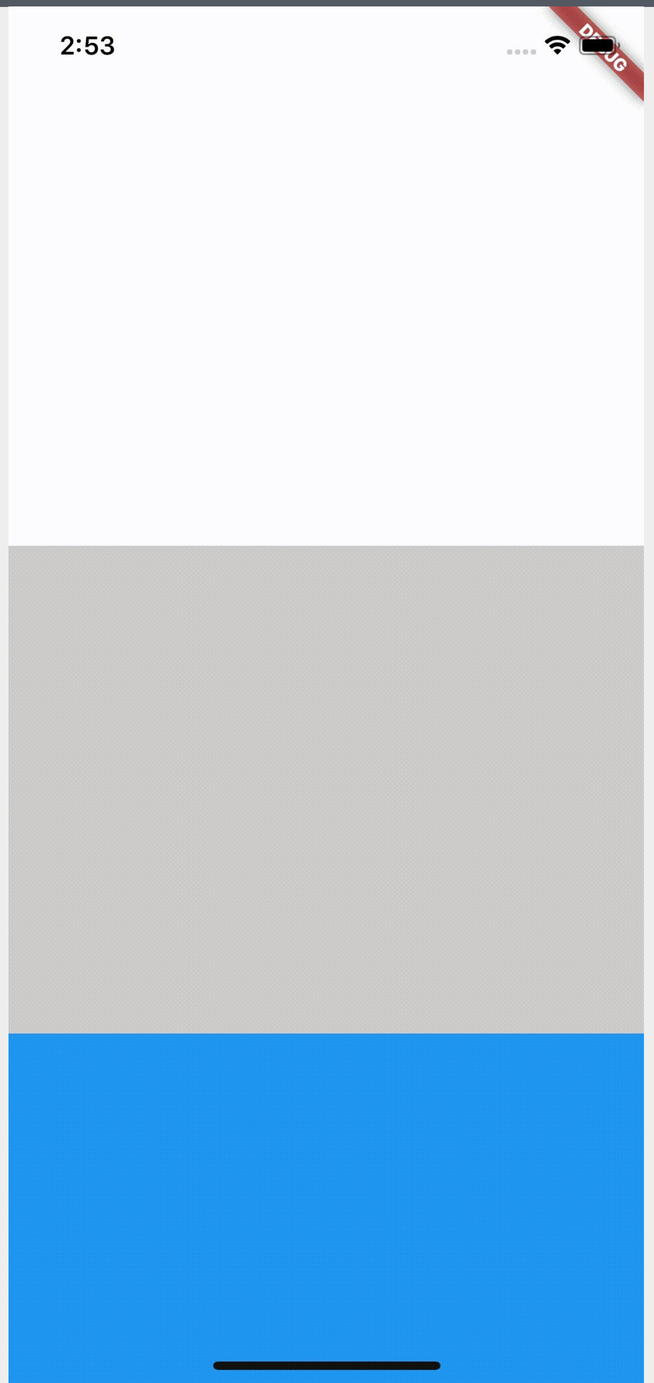
Our new Product Page

- Draggable Sheet which becomes Scrollable when fully extended (Google Maps style)
- Fade in a dark overlay when being dragged
  - should feel responsive to the user
  - When clicked, move the sheet back to initial position



Draggable Scrollable Sheet

- Flutter has one 🎉

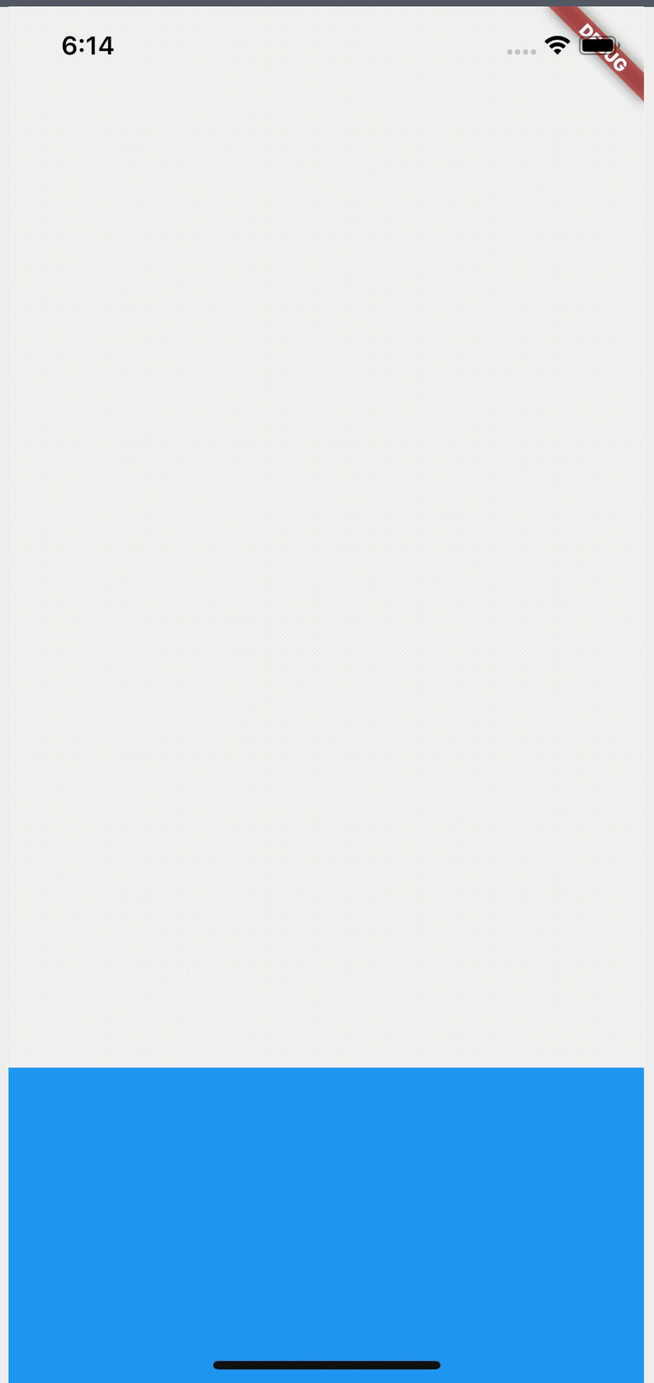


Independent animations approach

- Starting an independent animation when the sheet is being dragged
- We don’t know how long the user interaction will continue
  => How long should the animation run?

- What happens if the user changes the direction?
  => Synchronisation needed between two animations

- Animations will not be in sync with the interaction speed

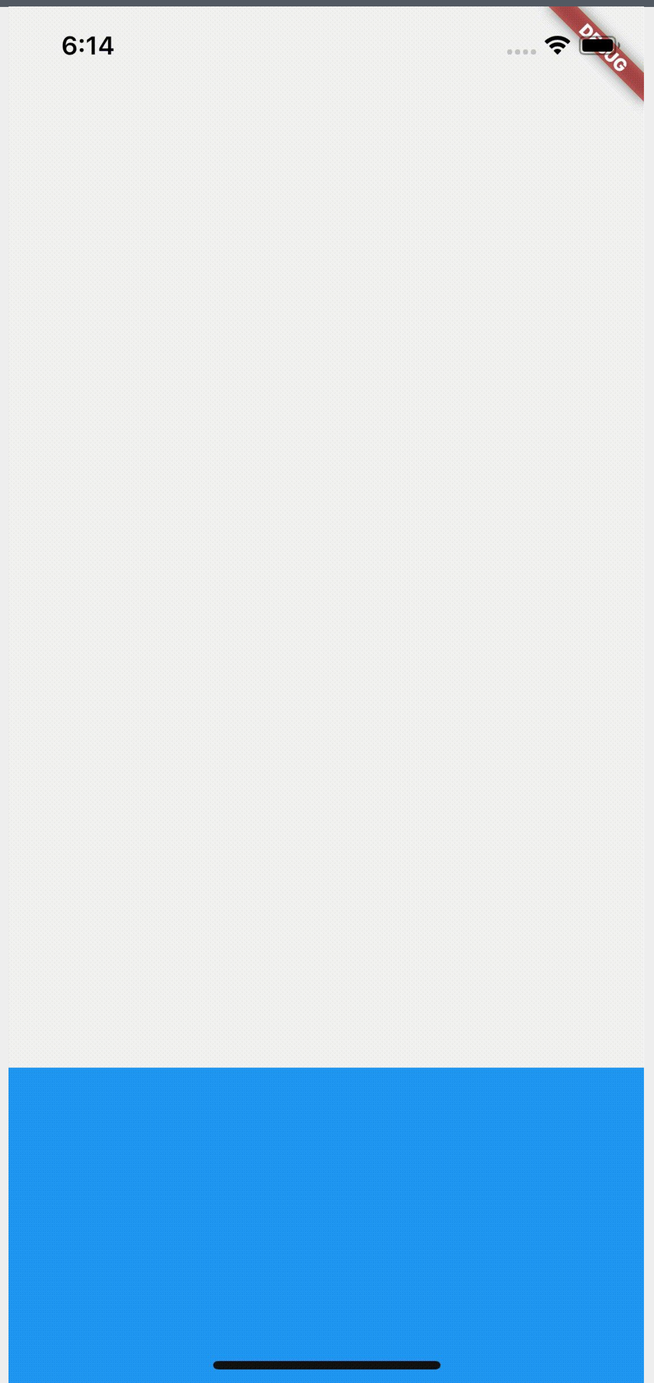


Solution: No animations at all

- No Synchronisation between interaction and animations needed
- “Animations” react to the speed of the user interaction
- Code for the “animations” is minimal and easy to understand

```
return ValueListenableBuilder<double>(
  valueListenable: measurements.currentSheetExtent,
  builder: (context, currentExtent, child) {
    final range = measurements.maxSheetExtent -
measurements.initialSheetExtent;

    final position = currentExtent - measurements.initialSheetExtent;

    final percentage = position / range;

    return Container(
      color: Colors.black.withOpacity(
        0.7 * percentage,
      ),
    );
  },
);
```

Let’s see some code



Driving Animations through Animation

- Moving the sheet to it's initial position

```dart
final controller = AnimationController(
  duration: Duration(milliseconds: 200),
  vsync: this,
);

final animation = Tween<double>(

  begin: measurements.currentSheetExtent.value,
  end: measurements.initialSheetExtent,
).animate(controller);

animation.addListener(() {
  measurements.currentSheetExtent.value = animation.value;
});

controller.forward();
```

Let’s see some code

Thanks!

Q & A

- From React Native to Flutter
- State Management
- Golden File Testing
- Developing Interactions