Rust Nation UK

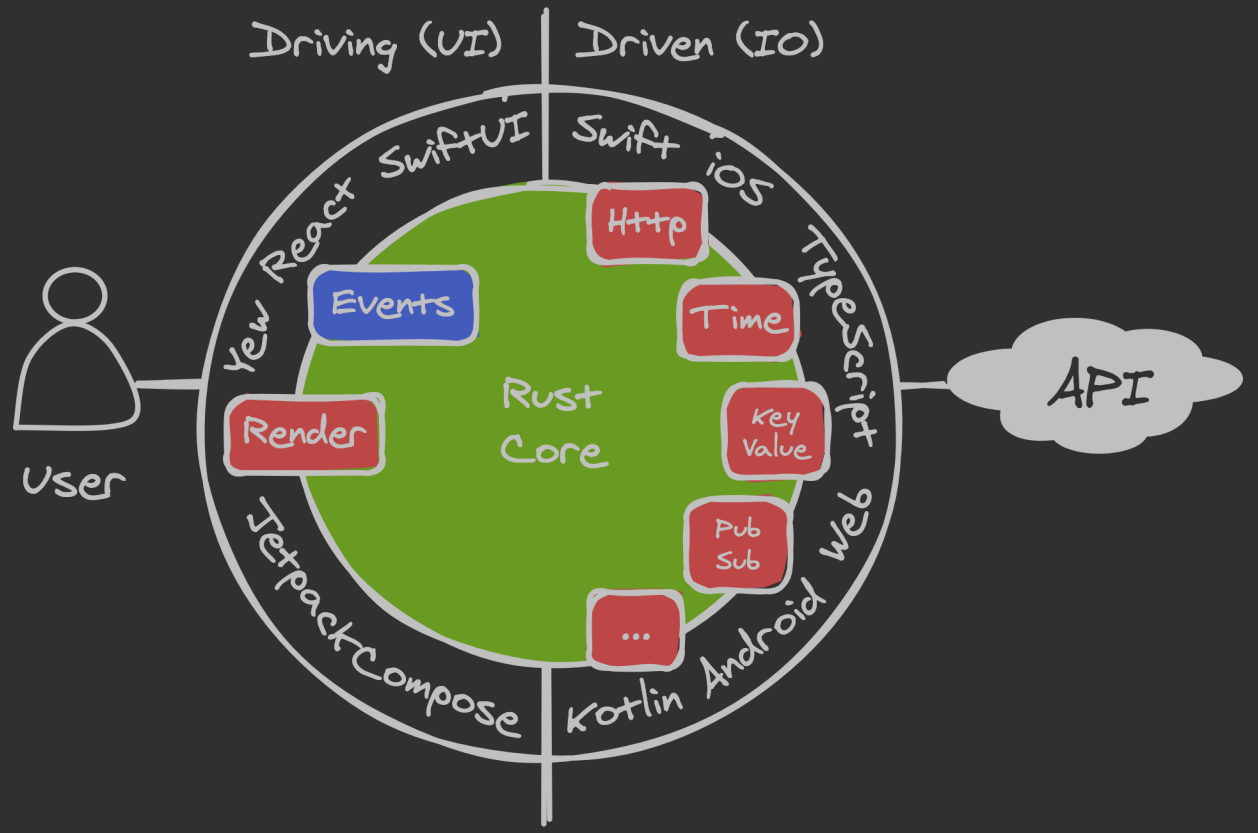
iOS, Android and Web apps in Rust

a.k.a. Headless apps

17.feb.2023

Stuart Harris

Founder & Chief Scientist, Red Badger



What are we talking about today?

- What do we mean by "Headless apps"?
- What does the landscape look like?
- How can we improve on this?
- Introduce Crux, a new open source "library" for building headless apps.

Hi, I'm Stu

- Founder of Red Badger
- Software engineer

RED BADGER

What are headless apps?

- Share *behaviour* across platforms
- Pure Core (push side effects to the edge)
- Strict contract between Core and Shell
- Acknowledge that platforms are best at UI …
  - … and that UI is a side effect
- All about *testability*
- Ports & Adapters (Hexagonal, Clean, Onion Architecture)

Motivation

- JavaScript is a mess! Layer on top of layer. On top of sand.
- There is no known implementation of Ports and Adapters in this space
- Shift left on app quality
- Testing apps shouldn't be hard
- Don't do it twice. Or even 3 times.

https://redbadger.github.io/crux/motivation.html

Platform Native

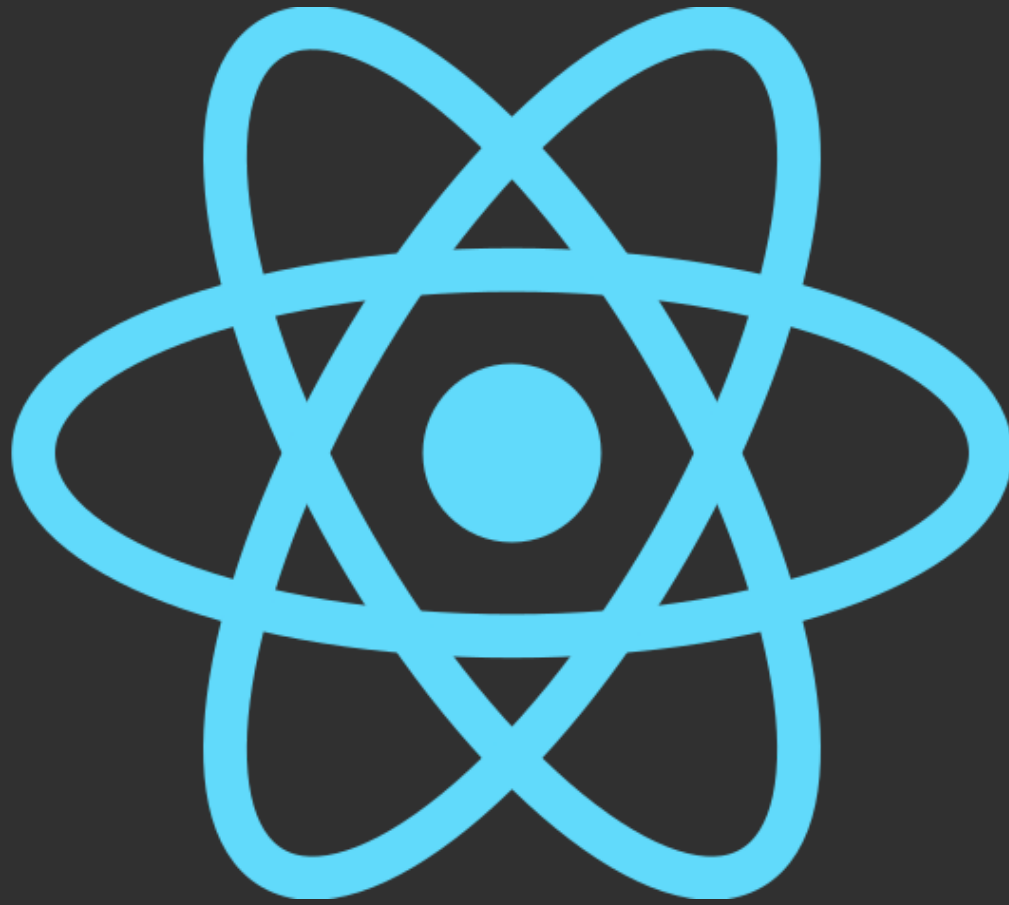
- Platform-native UX
- Nothing is shared (but full control)
- Siloed teams (Swift, Kotlin)
- Twice the cost?
- Web?

https://developer.apple.com/xcode/swiftui/
https://developer.android.com/jetpack/compose

React Native

- Good UX (sometimes need to dig in)
- Shared logic
- Teams do TypeScript (but native needed)
- Maintenance can be problematic

https://reactnative.dev/



Flutter

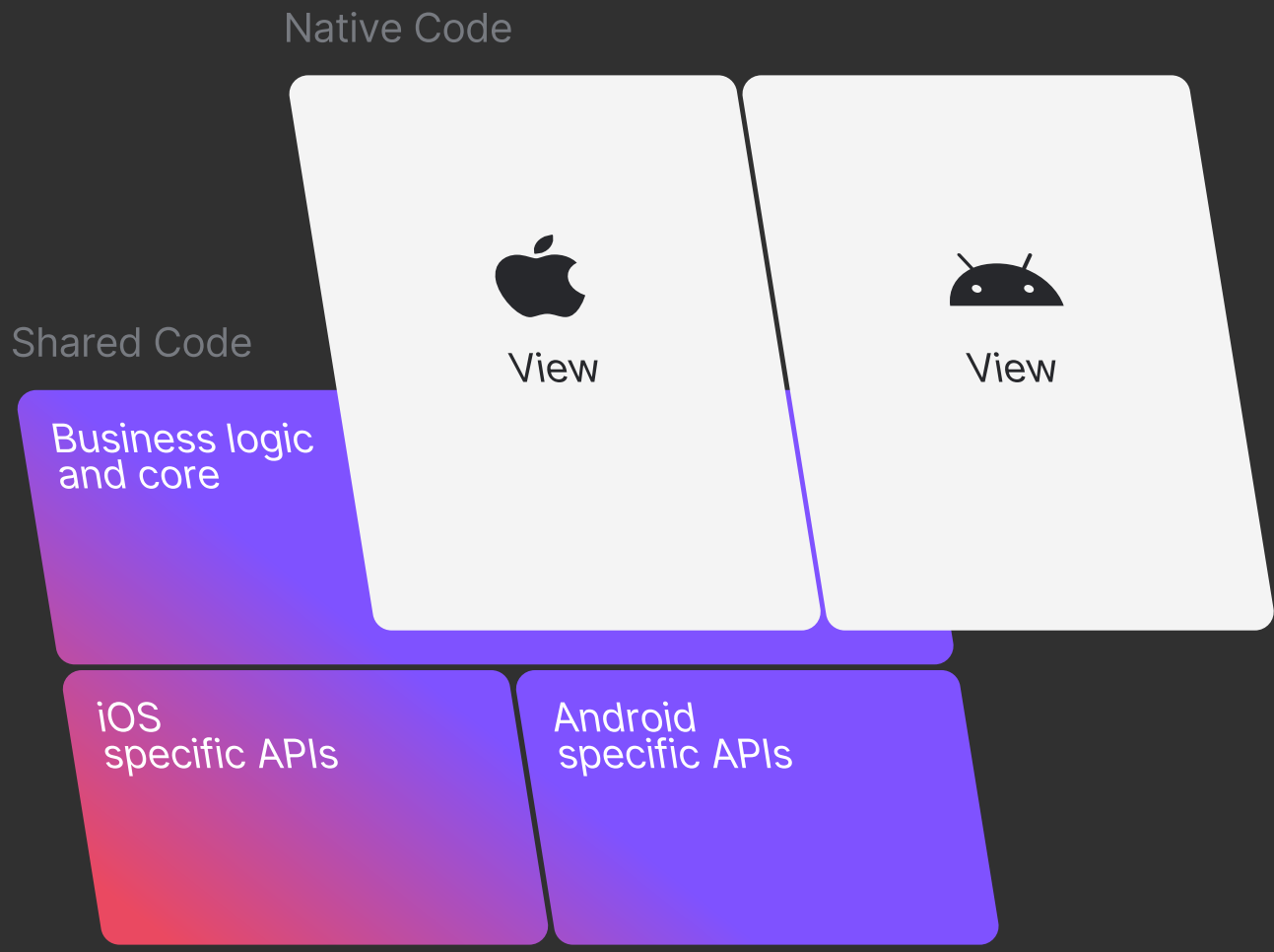
- Full stack (UX/UI not native, but Cupertino/Material flavours)
- Everything shared
- Plugins
- Teams do Dart

https://flutter.dev/

Kotlin Multi-platform Mobile

- Platform-native UX
- Shared logic
- Access to native APIs
- Teams do Kotlin (and Swift)

https://kotlinlang.org/lp/mobile/



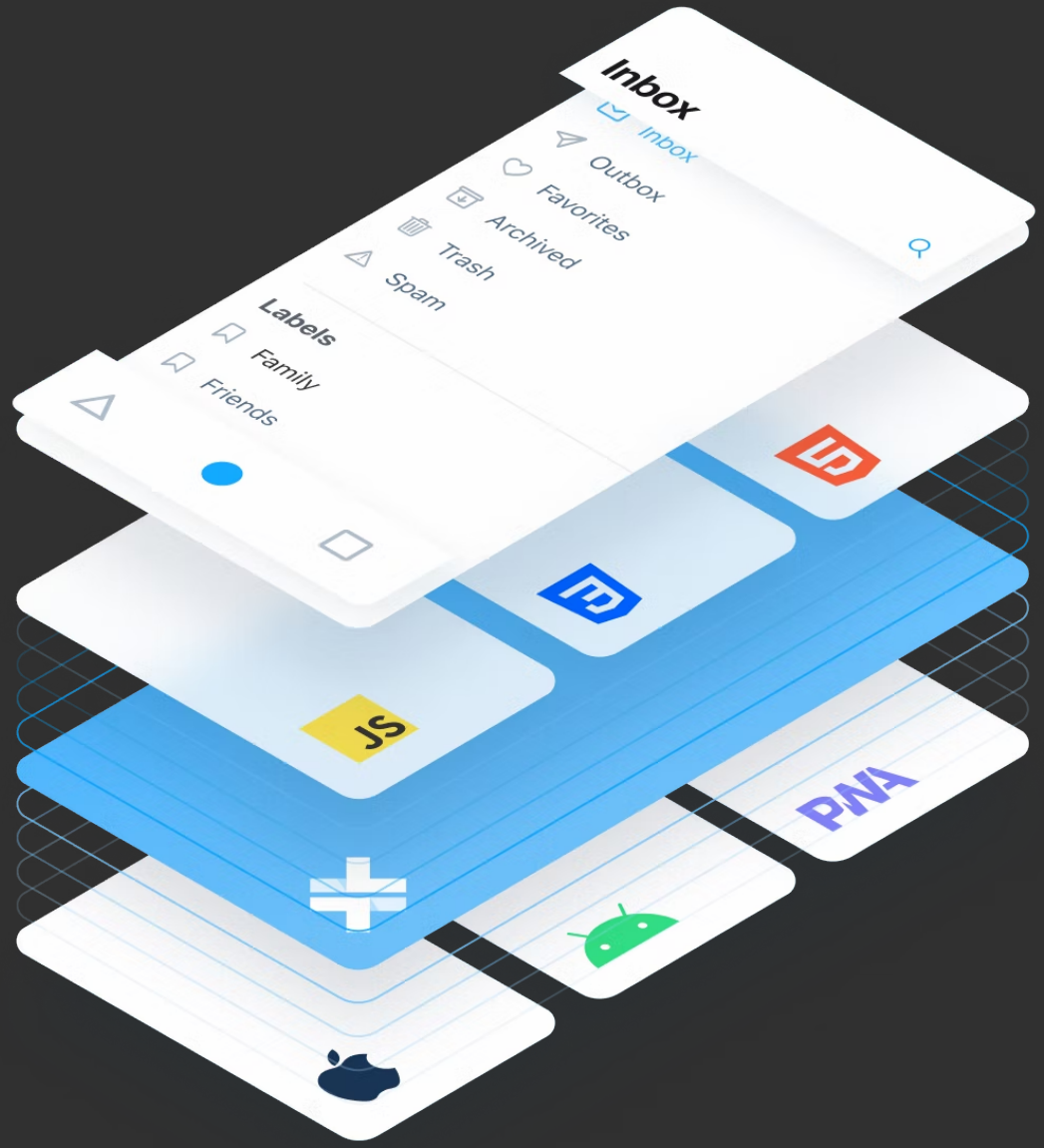
Capacitor / Ionic

- Hybrid (any Web stack)
- Access to native APIs
- Plugins
- Teams do TypeScript

https://capacitorjs.com/

https://ionicframework.com/

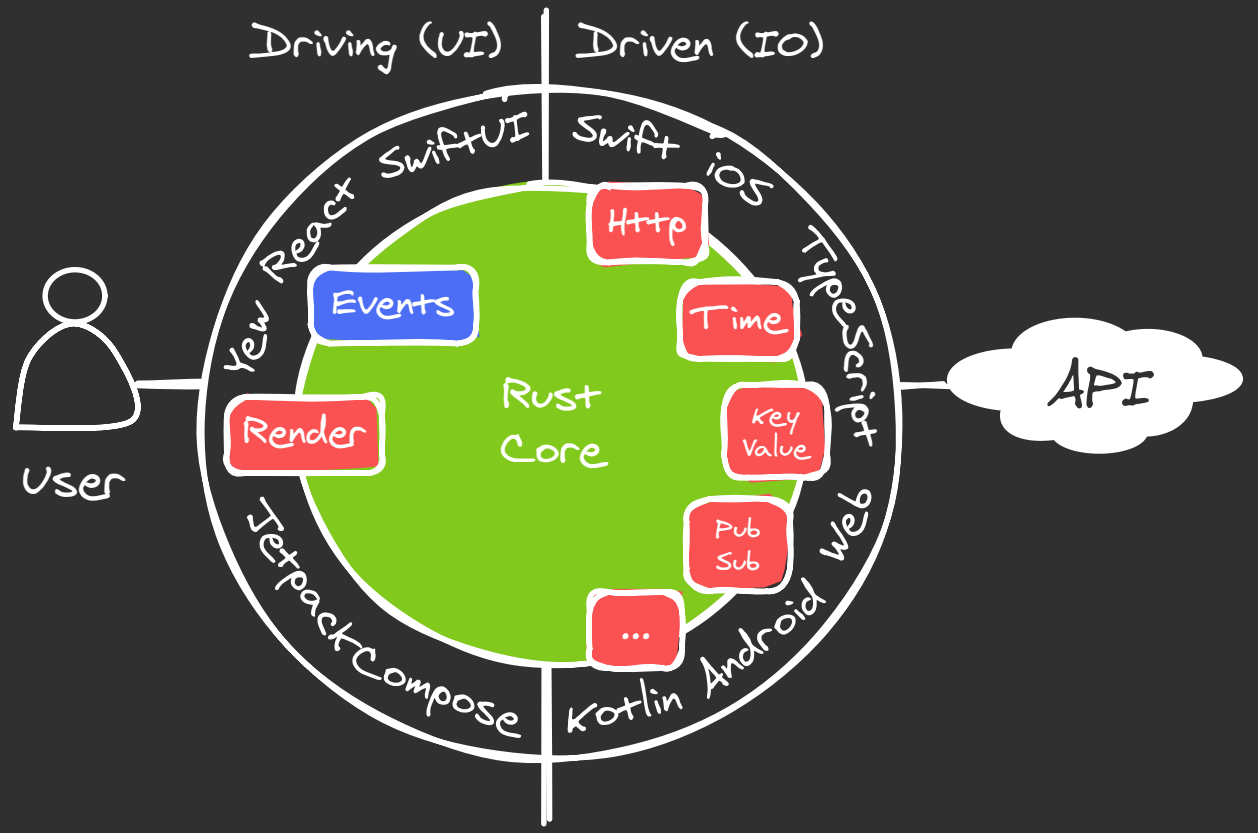
One to watch:
https://tauri.app/blog/2022/12/09/tauri-mobile-alpha/



Building a multi-platform app (don't @ me!)

	Platform Native	Kotlin MM	React Native	Capacitor Ionic	Flutter
Native UX	✅	✅	😐	❌	❌
Web?	❌	😐	😐	✅	✅
Development	😐	✅	😐	✅	✅
Testing	😐	😐	🤯	🤯	😐
Maintenance	😐	✅	😡	😡	✅
Effort	3x	2x	2x	1.5x	1.4x

CRUX


Driving (UI)
Driven (IO)
Yew
React
SwiftUI
Swift
iOS
TypeScript
Web
Android
Kotlin
JetpackCompose
Http
Events
Time
Render
Rust
Core
Key
Value
Pub
Sub
...
User
API

Crux

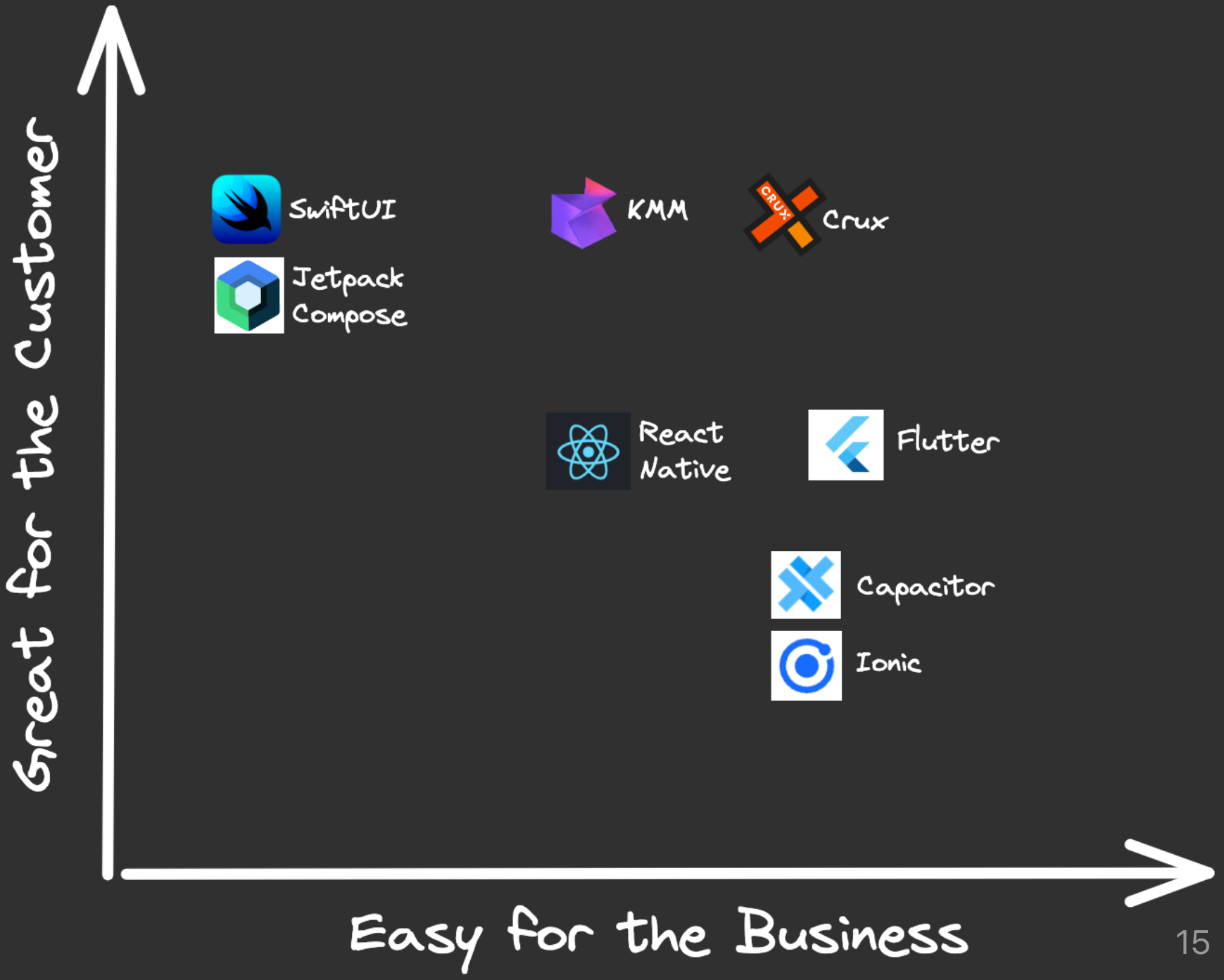
- Platform-native UX
- Shared *behaviour*
- Capabilities
- Teams do Rust 
- (and Swift, Kotlin, TypeScript)

https://redbadger.github.io/crux

Building a multi-platform app (don't @ me!)

	Platform Native	Kotlin MM	React Native	Capacitor Ionic	Flutter	Crux
Native UX	✅	✅	😐	❌	❌	✅
Web?	❌	😐	😐	✅	✅	✅
Development	😐	✅	😐	✅	✅	✅
Testing	😐	😐	🤯	🤯	😐	🤩
Maintenance	😐	✅	😡	😡	✅	✅
Effort	3x	2x	2x	1.5x	1.4x	1.4x

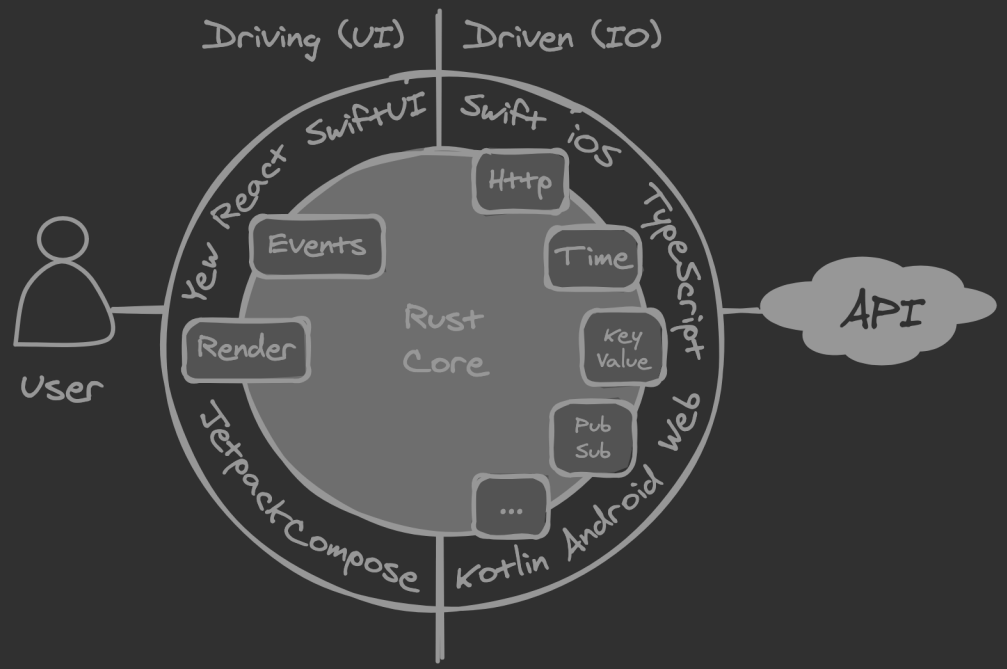
Who benefits?



Ports and adapters

> Allow an application to equally be driven by users, programs, automated test or batch scripts, and to be developed and tested in isolation from its eventual run-time devices and databases.

Alistair Cockburn, “Hexagonal architecture“, 2005



Ports and adapters

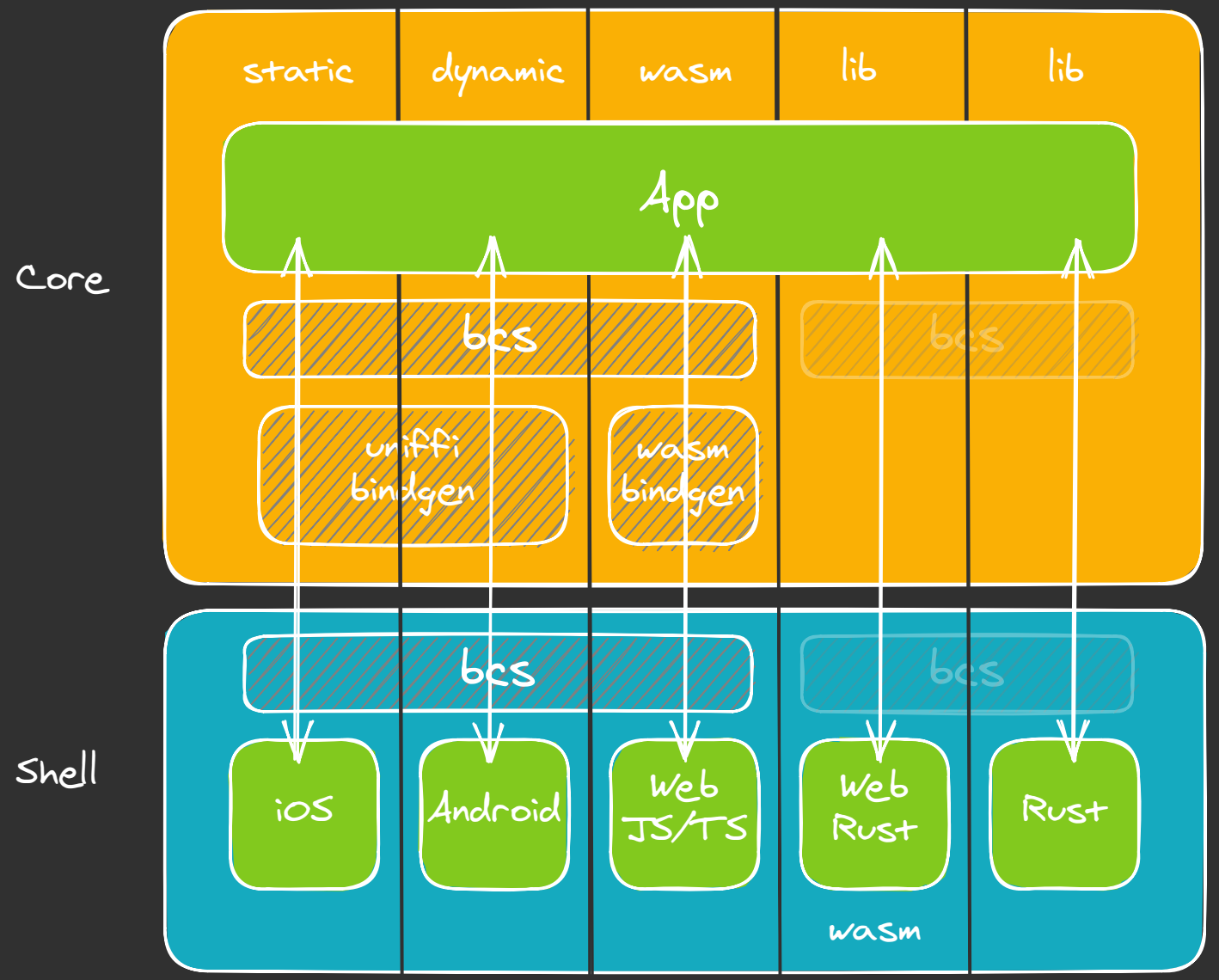
> The application can be deployed in “headless” mode, so only the API is available, and other programs can make use of its functionality

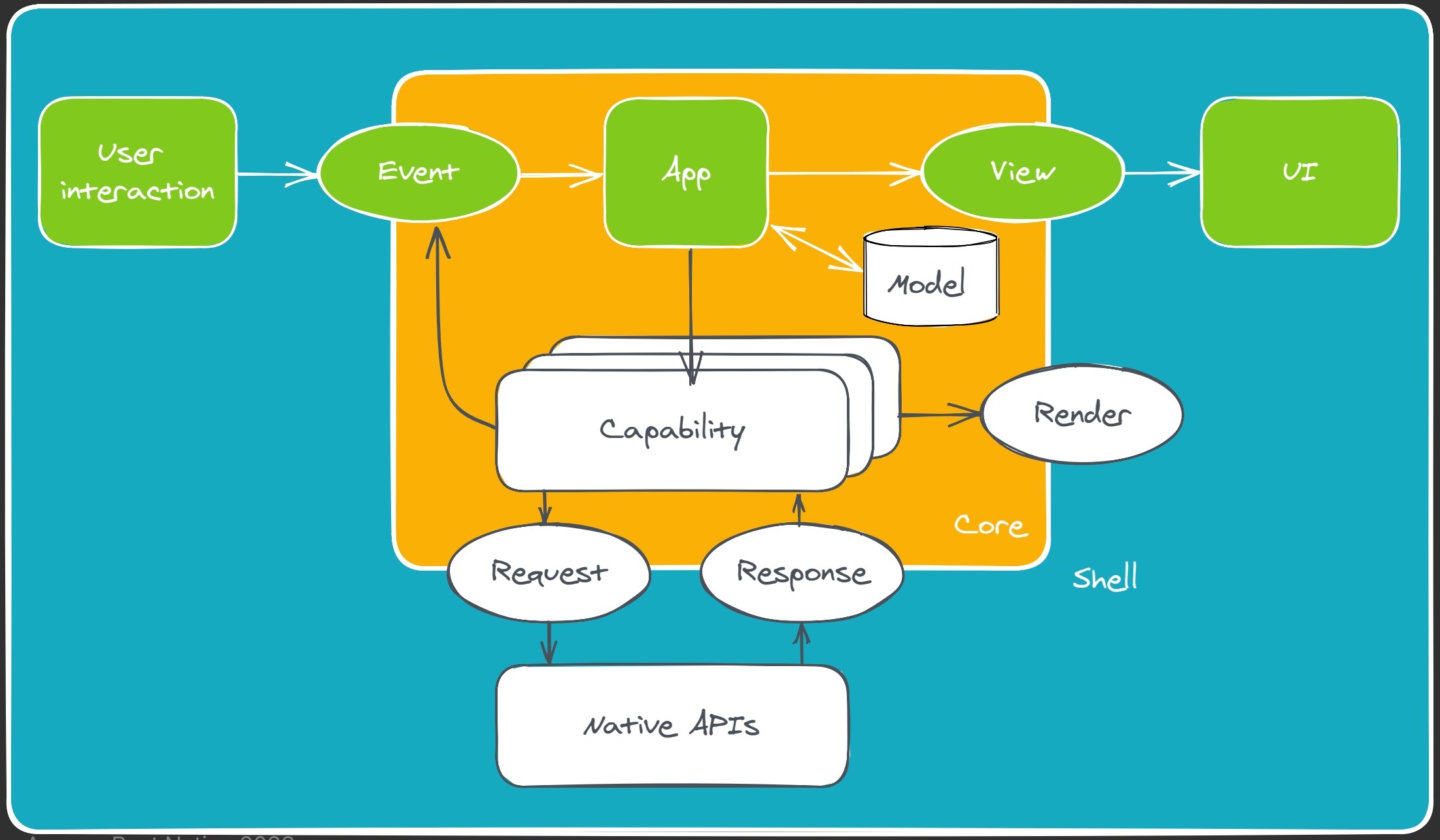
Alistair Cockburn, “Hexagonal architecture“, 2005

Any client

	iOS	Android	Web	Web	CLI
language	Swift/ObjC	Kotlin/Java	JS/TS	Rust	Rust
UI	SwiftUI/UIKit	Compose/View-based	Next.js/React	Yew	-
library	static	dynamic (JNA)	wasm	crate	crate
lib name	`libshared.a`	`libshared.so`	`shared.wasm`	-	-
FFI	`uniffi-bindgen`	`uniffi-bindgen`	`wasm-bindgen`	-	-

Type generation with `serde-generate`


Core
Shell
static
dynamic
wasm
lib
lib
App
bcs
bcs
uniffi bindgen
wasm bindgen
bcs
bcs
iOS
Android
Web JS/TS
Web Rust
Rust
wasm


User interaction
Event
App
View
UI
Model
Capability
Render
Core
Request
Response
Shell
Native APIs

Capabilities

- Fire and forget `caps.render.render();`
- Request/response `caps.http.get(API_URL).expect_json().send(Event::Set);`
- Streaming `caps.sse.get_json(API_URL, Event::Update);`

Capabilities

- Built-in (`Render`)
- `crux_*` crates (`Http` , `KeyValue` , `Platform` , `Time`)
- Custom
  - `ServerSentEvents` in the Counter example
  - `Delay` example in the book
  - `Timer` and `PubSub` in the Notes example
- Community contributed

What does a Crux app look like?

```rust
#[derive(Default)]
pub struct Hello;

impl App for Hello {
    type Event = Event;
    type Model = Model;
    type ViewModel = ViewModel;
    type Capabilities = Capabilities;

    fn update(&self, event: Self::Event, model: &mut Self::Model, caps: &Self::Capabilities) {
        match event {
            Event::Increment => model.count += 1,
            Event::Decrement => model.count -= 1,
            Event::Reset => model.count = 0,
        };

        caps.render.render();
    }

    fn view(&self, model: &Self::Model) -> Self::ViewModel {
        ViewModel {
            count: format!("Count is: {}", model.count),
        }
    }
}
```

What does a test look like?

```rust
#[cfg(test)]
mod test {
    use super::*;
    use crux_core::{render::RenderOperation, testing::AppTester};

    #[test]
    fn increments_count() {
        let app = AppTester::<Hello, _>::default();
        let mut model = Model::default();

        let update = app.update(Event::Increment, &mut model);

        // Check the app asked us to `Render`
        let actual_effect = &update.effects[0];
        let expected_effect = &Effect::Render(RenderOperation);
        assert_eq!(actual_effect, expected_effect);

        // Check view model is correct
        let actual_view = app.view(&model).count;
        let expected_view = "Count is: 1";
        assert_eq!(actual_view, expected_view);
    }
}
```

Demo

Headless app development in Rust

The crux of Crux

- a lightweight runtime
  - for headless, multi-platform, composable apps with shared behaviour
  - for better testability
  - for higher code and behaviour reuse
  - for better safety and security
  - and more *joy* from better tools

What's next?

- Build a community
- Build some big apps
- Improve ergonomics and DX — docs, book, sharp edges, testing
- Crux Doctor
- Evolve capabilities (and add shell-side code)
- You tell us?

Summary

- Headless apps share behaviour across platforms
- That behaviour can be easily and exhaustively tested
- Test feedback is very fast, allowing you to be more productive
- Crux can get you moving quickly

We love Tech

Rust in the Enterprise

Post-Rust Nation conference brunch and hands-on code deep-dive into a brand new open-source framework that is set to revolutionise your ability to write it once, test it once, and deploy it everywhere.

https://content.red-badger.com/events/rust-in-the-enterprise

Big thanks to

- Viktor Charypar https://twitter.com/charypar
- Graeme Coupar https://twitter.com/obmarg

Thank you!

- Stuart Harris https://twitter.com/stuartharris
- Github https://github.com/redbadger/crux
- Book https://redbadger.github.io/crux
- Event tomorrow https://content.red-badger.com/events/rust-in-the-enterprise