Full Stack Type Safety

with `TypeScript` and `io-ts`

buildo

software that fits

TS

Agenda

1. Intro to `io-ts`
2. Full stack type safety

Focus

Discover issues *as early as possible*

Example Code

github.com/giogonzo/ts-conf-talk

Demo + Code Overview

github.com/giogonzo/ts-conf-talk

```
git checkout step-0
```

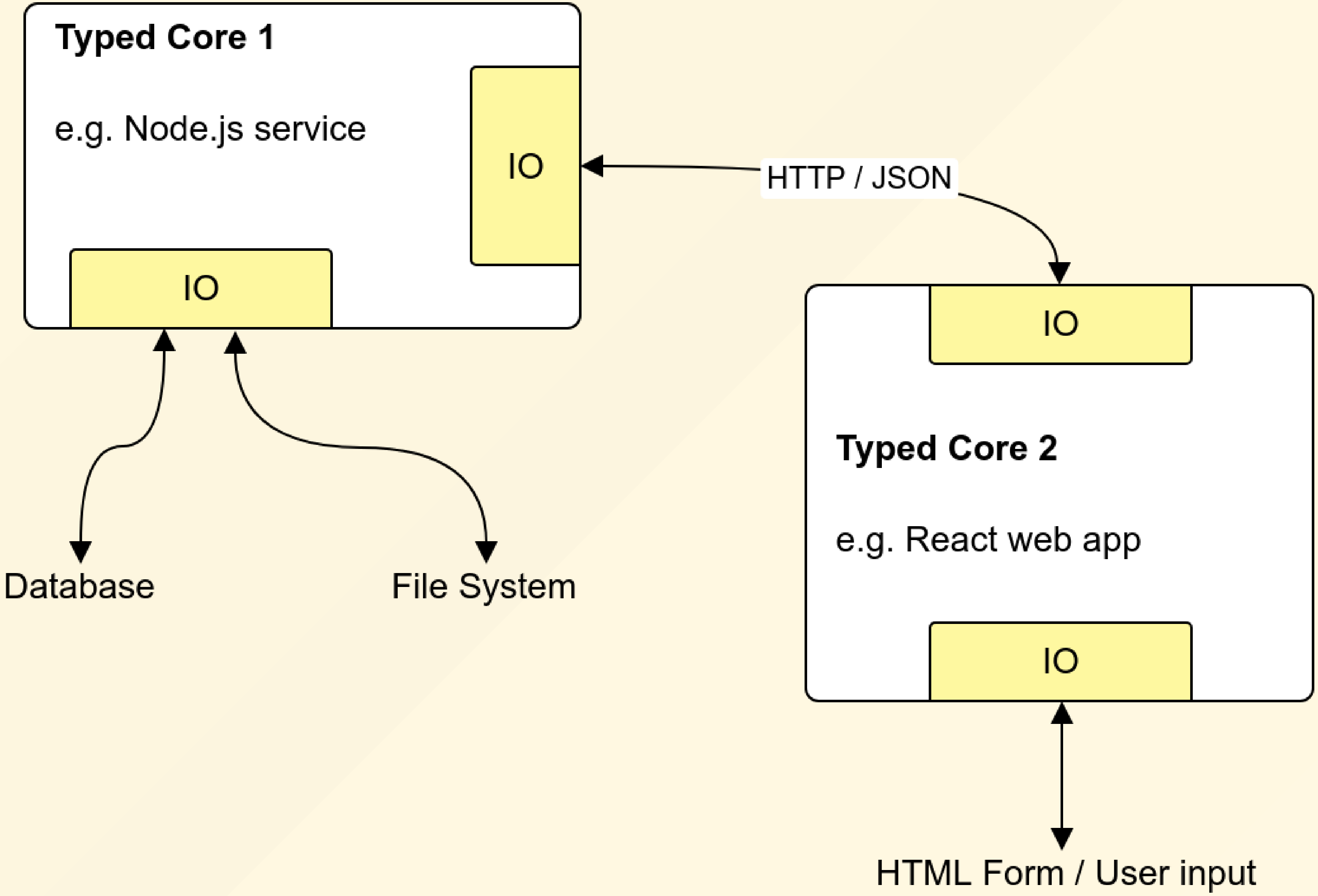
IO decoding / encoding

`TypeScript`

- Helps inside the statically typed core

`io-ts`

- Helps enforcing IO contracts at *runtime*
- Encourages pushing (de/en)coding to the boundary of our statycally typed cores


Typed Core 1
e.g. Node.js service
IO
IO
HTTP / JSON
Database
File System
IO
Typed Core 2
e.g. React web app
IO
HTML Form / User input

Meet `io-ts`

1. Define "codecs" in the `io-ts` DSL (values)

```
import * as t from "io-ts";

const User = t.type(
  {
    name: t.string,
    age: t.number,
    languages: t.array(t.string)
  },
  "User"
);
```

Meet `io-ts`

1. Define "codecs" in the `io-ts` DSL (values)

```
import * as t from "io-ts";

const User = // ...
```

- primitive codecs: `string`, `number`, `boolean` and more
- combinators: `array`, `type`, `union`, `intersection` and more
- companion library: github.com/gcanti/io-ts-types
- make your own codecs! `new t.Type(...)`

Meet `io-ts`

2. Static types can be derived from codec values using the type-level operator `TypeOf`

```
type User = t.TypeOf<typeof User>;

// equivalent to:
//
// type User = {
//   name: string;
//   age: number;
//   languages: Array<string>;
// };
```

Meet `io-ts`

3. Codecs are used at runtime for decoding and encoding values

```
const decodeResult = User.decode(unknownValue);

// decodeResult: Either<t.Errors, User>
```

```
type Either<L, A> = Left<L> | Right<A>;
```

Meet `io-ts`

3. Codecs are used at runtime for decoding and encoding values

```
const decodeResult = User.decode({
  name: "gio",
  languages: ["Italian", "TypeScript"]
});

// Left<t.Errors>
```

```
PathReporter.report(decodeResult);

// ["Invalid value undefined supplied to : User/age: number"]
```

Meet `io-ts`

3. Codecs are used at runtime for decoding and encoding values

```
const decoded = User.decode({
  name: "gio",
  age: 30,
  languages: ["Italian", "TypeScript"]
});

// Right<User>
```

Meet `Type<A, O>`

A codec of type Type<A, O>

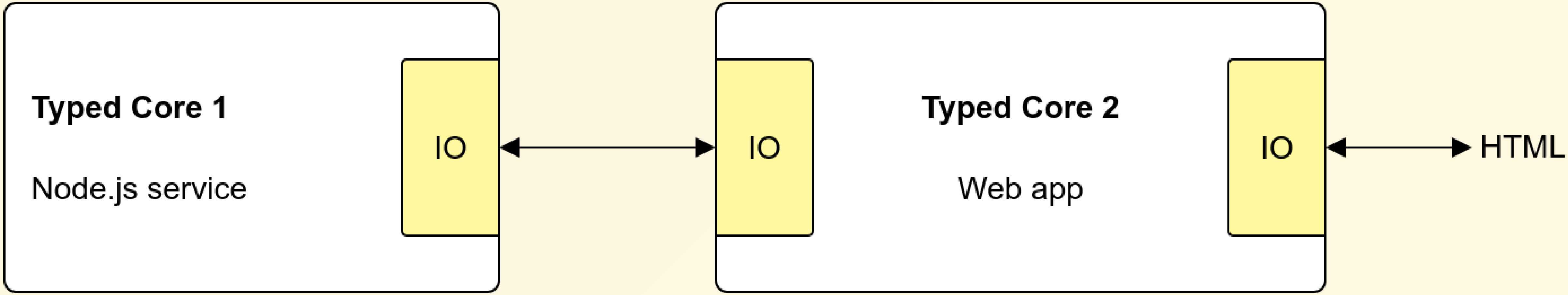
- represents the static type `A` at runtime
- can encode `A` into `O`
- can decode `unknown` into `A`, or fail with validation errors

Meet `Type<Date, string>`

For `User.birthDate` we'll need a codec that

- represents the static type `Date` at runtime
- can encode `Date` into `string`
- can decode the string back into `Date`, or fail with validation errors

Meet `Type<Date, string>`



`Date` `string` `Date` `string`

Let's see the code

github.com/giogonzo/ts-conf-talk

```
git checkout step-1
```

Full Stack Type Safety

The idea that a breaking change in layer X results in type errors at other layers

- In our example today: changing/adding/removing API calls

Full Stack Type Safety

Plenty of available solutions based on IDLs

- GraphQL
- OpenAPI
- …

Language-dependent solutions

- E.g. `Scala` to `TypeScript` github.com/buildo/metarpheus

Full Stack `TypeScript`

No impedance mismatch

- Same power to express concepts at both ends

No need for code generation

- Reuse the same code for domain definitions
- Derive features at runtime
- Enforce invariants at compile time

Moar code

github.com/giogonzo/ts-conf-talk

`git checkout step-2`, `step-3`, `step-4`

Summary

- `TypeScript` + `io-ts` make obtaining "full stack type safety" trivial
- More in general, how we can exploit TS to find problems *earlier*
- How designing in terms of DSL + "interpreters" makes an IO contract reusable

any question?