# Types Without Borders

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incrementalelm.com

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# JavaScript

```
let json = Json.parse(stringFromServer);
```

– `Json is not defined`

– **We meant** `JSON`

– **Don't know until runtime.**

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# Elm Compiler

- Knows a lot!
- Make impossible states impossible
- If it compiles it works! ™

# Custom `Msg` Types

```
type Msg
   = Increment



update msg model =
   case msg of
      Increment ->
         (model + 1, Cmd.none)
```

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# Add to `Msg`

```
type Msg
  = Increment
  | Decrement

update msg model =
  case msg of
    Increment ->
      (model + 1, Cmd.none)
```

— **This `case` does not have branches for all possibilities...**

# Single Source of Truth

```
type Msg
  = Increment
  | Decrement

update msg model =
  case msg of
    Increment ->
      (model + 1, Cmd.none)

    Decrement ->
      (model - 1, Cmd.none)
```

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# APIs in Elm

```elm
type Character
    = Human { name : String, homePlanet : String }
    | Droid { name : String, primaryFunction : String }

decoder : Decode.Decoder Character
decoder =
    Decode.field "type" Decode.string
        |> Decode.andThen
            (\characterType ->
                case characterType of
                    "human" -> humanDecoder
                    "droid" -> droidDecoder
                    _ -> Decode.fail "Invalid Character")
```

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# Nested Decoders

```elm
humanDecoder : Decode.Decoder Character
humanDecoder =
    Decode.map2 HumanAttributes
        (Decode.field "name" Decode.string)
        (Decode.field "homePlanet" Decode.string)
        |> Decode.map Human


droidDecoder : Decode.Decoder Character
droidDecoder =
    Decode.map2 DroidAttributes
        (Decode.field "name" Decode.string)
        (Decode.field "primaryFunction" Decode.string)
        |> Decode.map Droid
```

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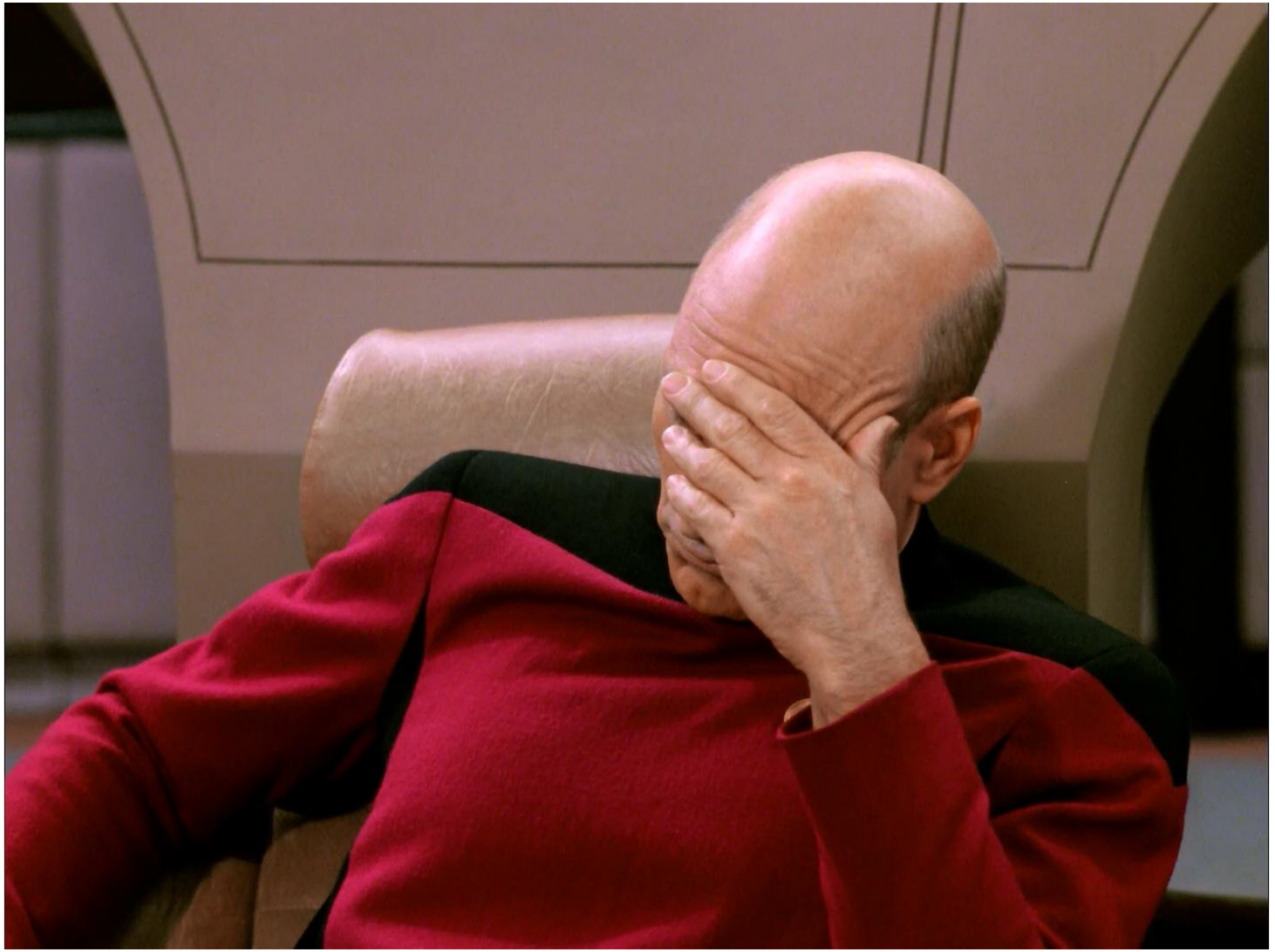
# `BadPayload`

**Expecting an object with a field named `name` but instead got...**



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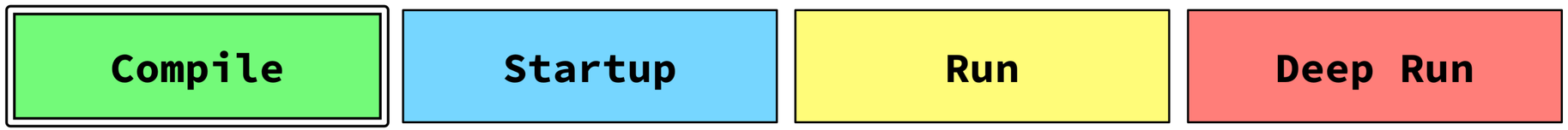
# JS Implicit Assumptions

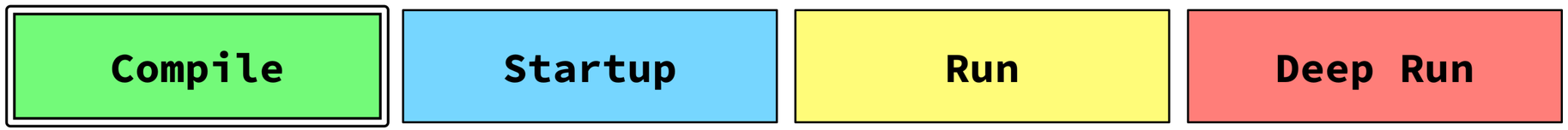
```
greet(jsonResponse.name);
```

- `"Hello [object Object]!"`
- **Explicit assumptions are nice (e.g.** `Result`**)**
- **No assumptions is best**

# When Can I Know?



# When Can I Know?




`Msg` `Flags` `Decoder` `greet`

# Uncertainty

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# Uncertainty

## 1. Unavoidable

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# Uncertainty

## 1. Unavoidable
## 2. Avoidable

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# Unavoidable Uncertainty

```
type Error
    = BadStatus (Response String)
    | Timeout
    | NetworkError
```

— **Can't guarantee WiFi** 📶

— **Representing unavoidable uncertainty** 👍

# Avoidable Uncertainty

```
type Error
    = BadStatus (Response String)
    | Timeout
    | NetworkError
    | BadUrl String
```

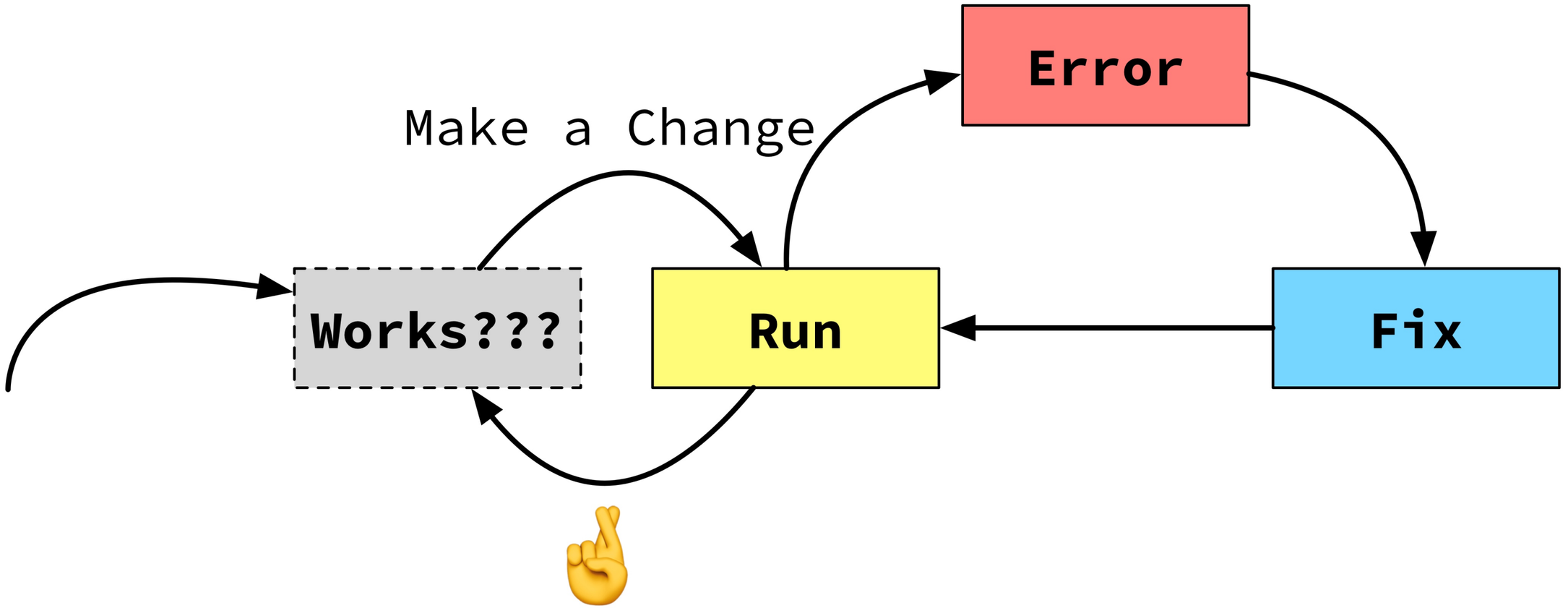
— **Could make this impossible.**

# Avoidable Uncertainty

```
type Error
    = BadStatus (Response String)
    | Timeout
    | NetworkError
    | BadUrl String
    | BadPayload String (Response String)
```

— Two sources of truth

# Avoidable Uncertainty

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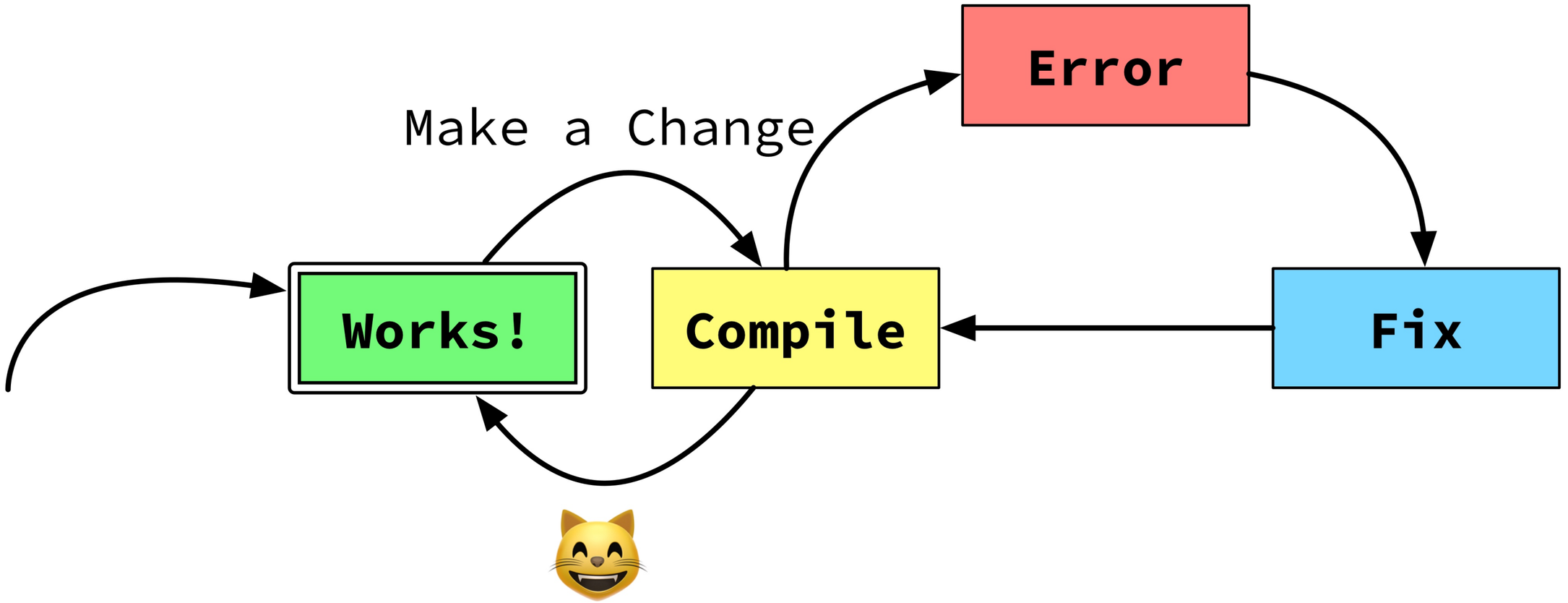
# With Certainty

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# Single Source of Truth

```
type Msg
  = Increment
  | Decrement

update msg model =
  case msg of
    Increment ->
      (model + 1, Cmd.none)

    -- You forgot a case!
```

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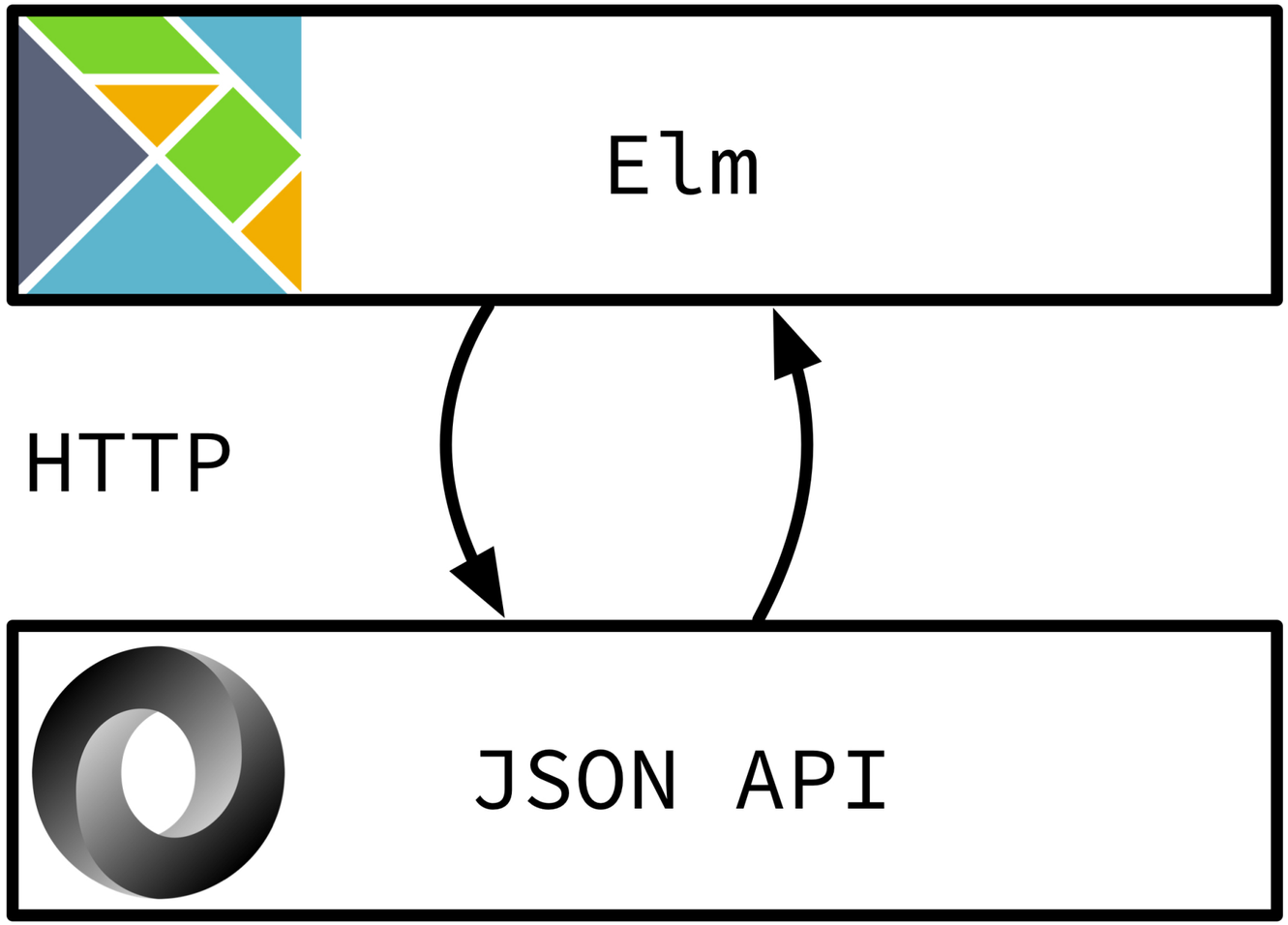


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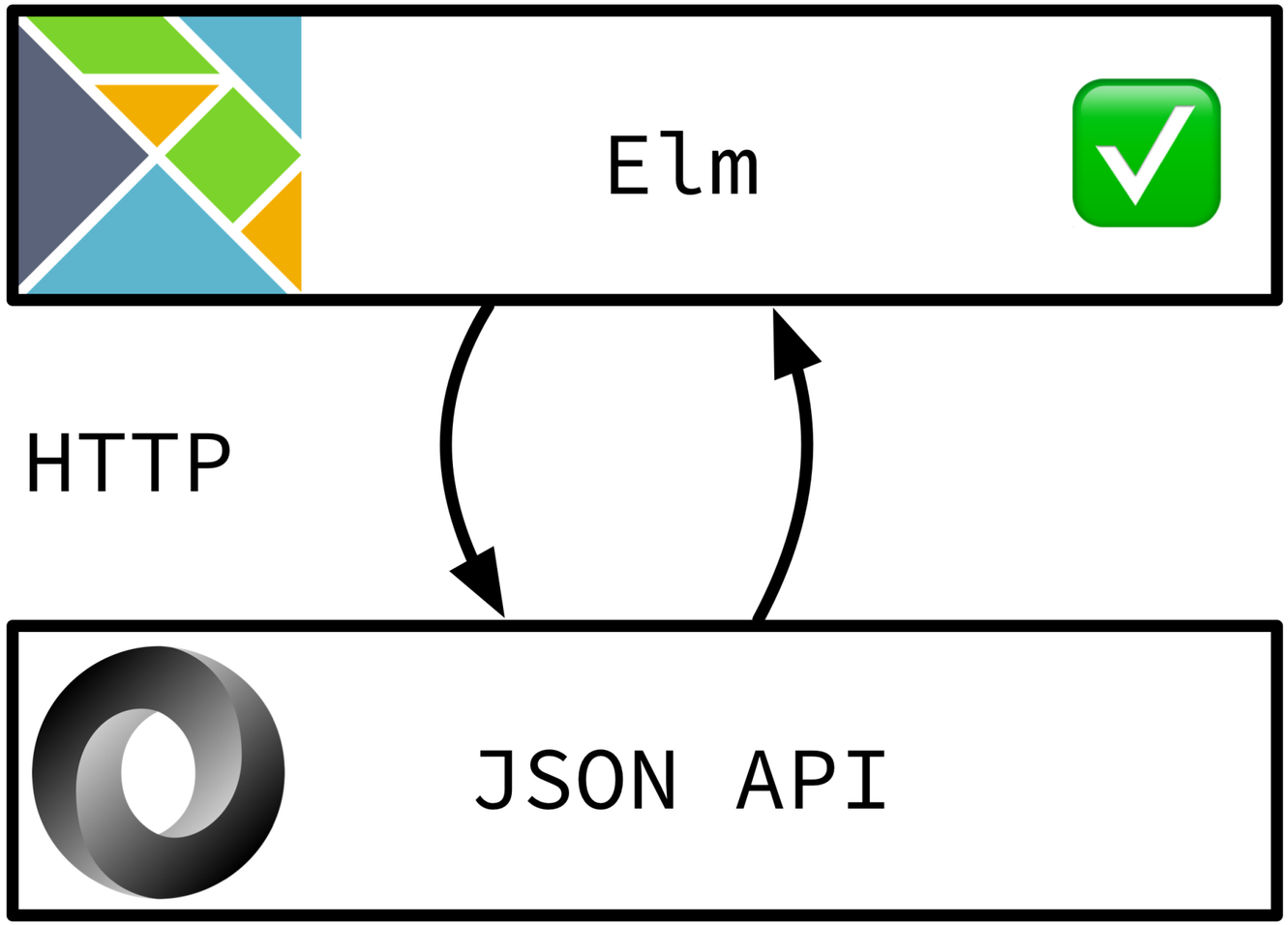


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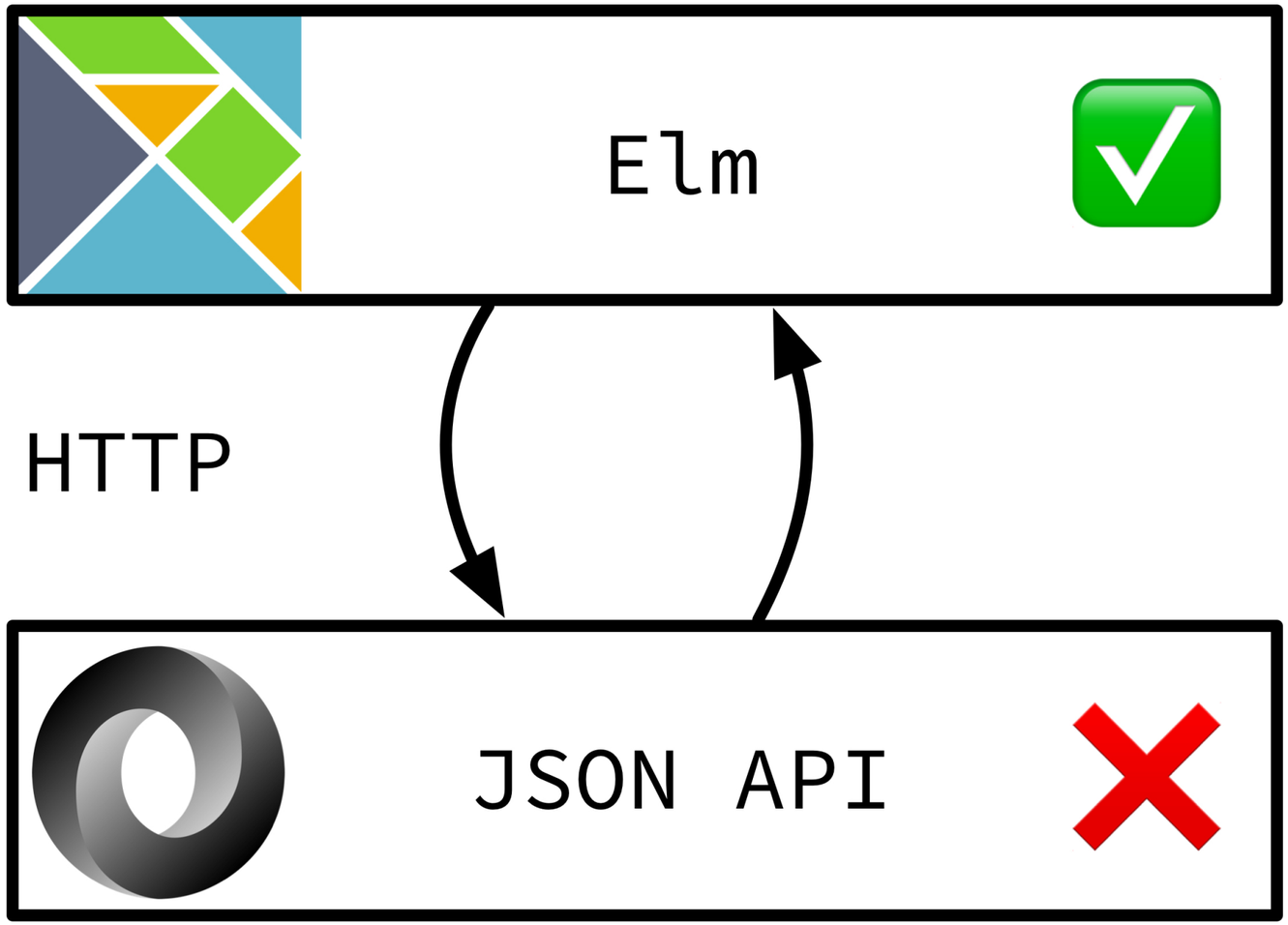


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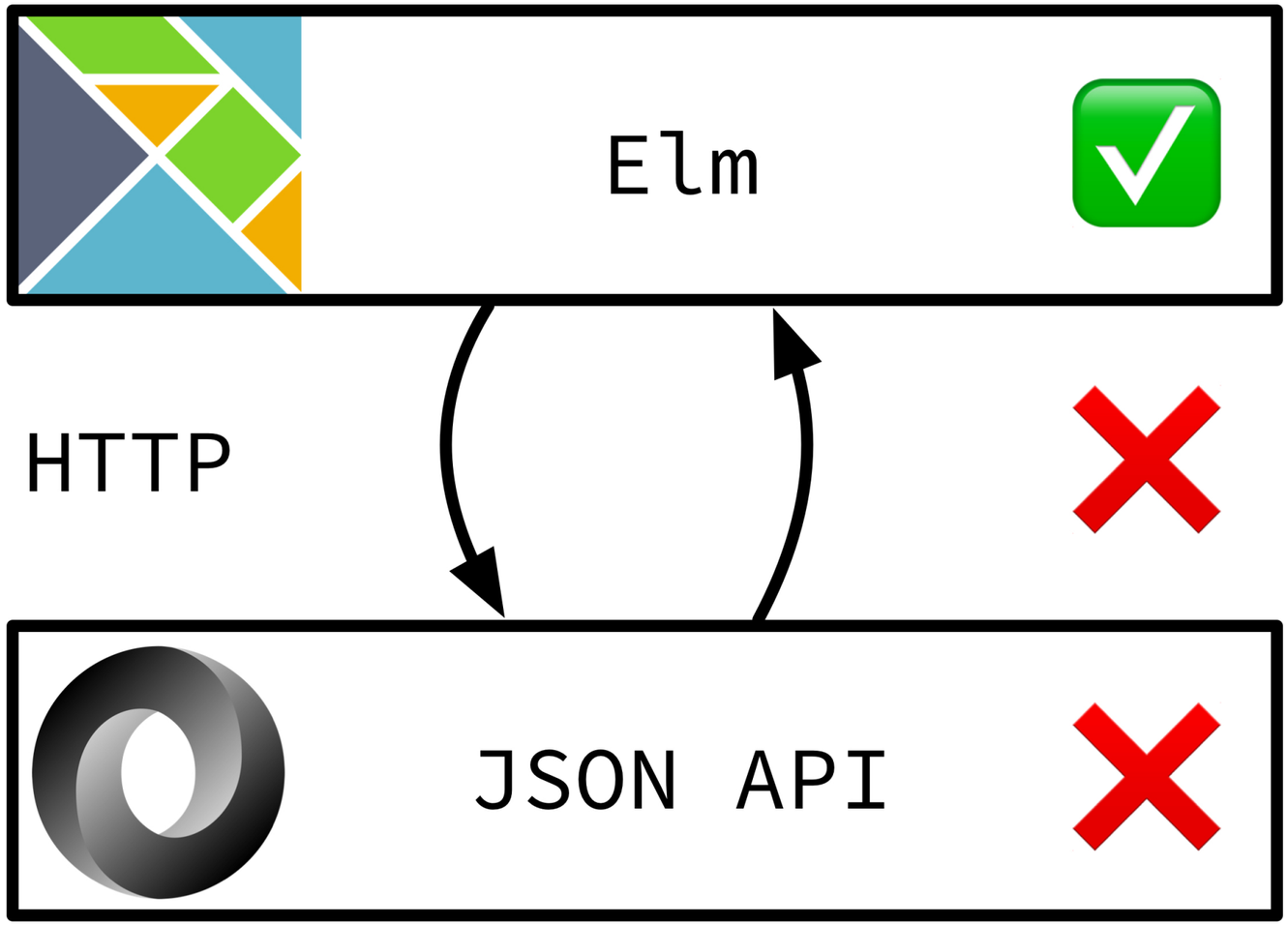


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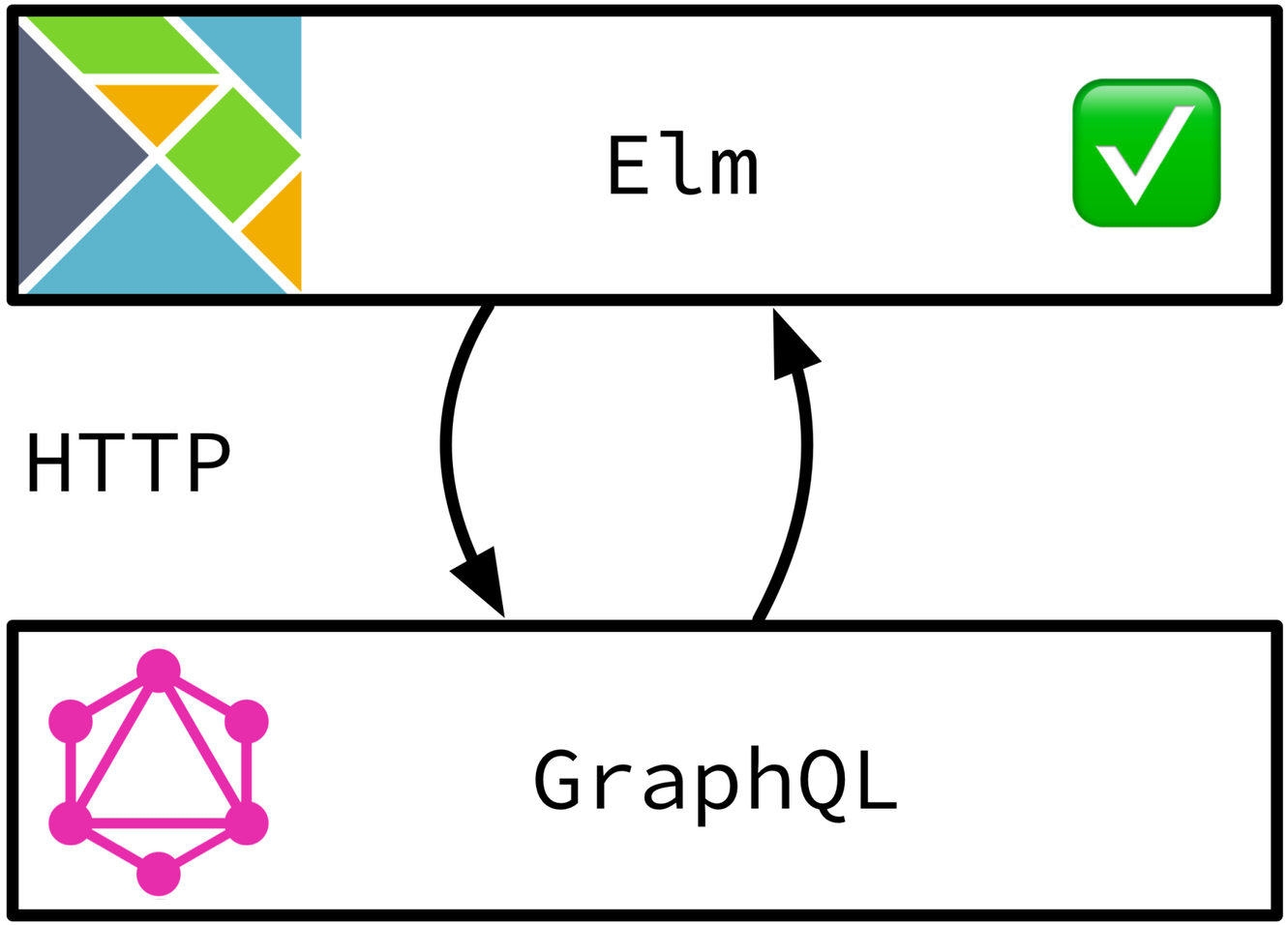


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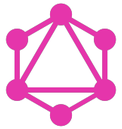
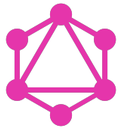


# GraphQL

— Strong guarantees
— Enforces contract
— Robust type system



# GraphQL Enums

```
enum SortOrder {
  ASCENDING
  DESCENDING
}
```

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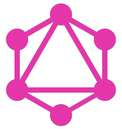

# GraphQL Objects

```
type Character {
  name: String!
  homePlanet: String
  avatarUrl: String!
  friends: [Character!]!
}
```

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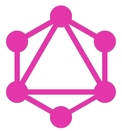
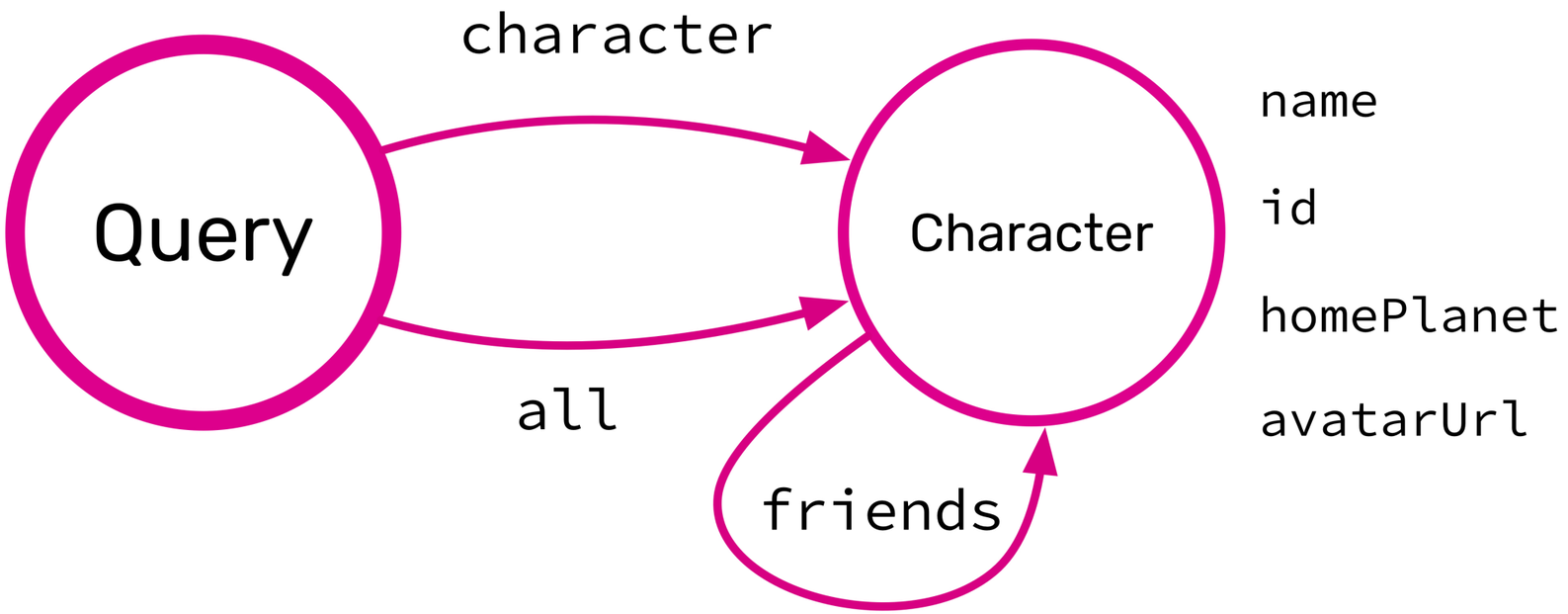
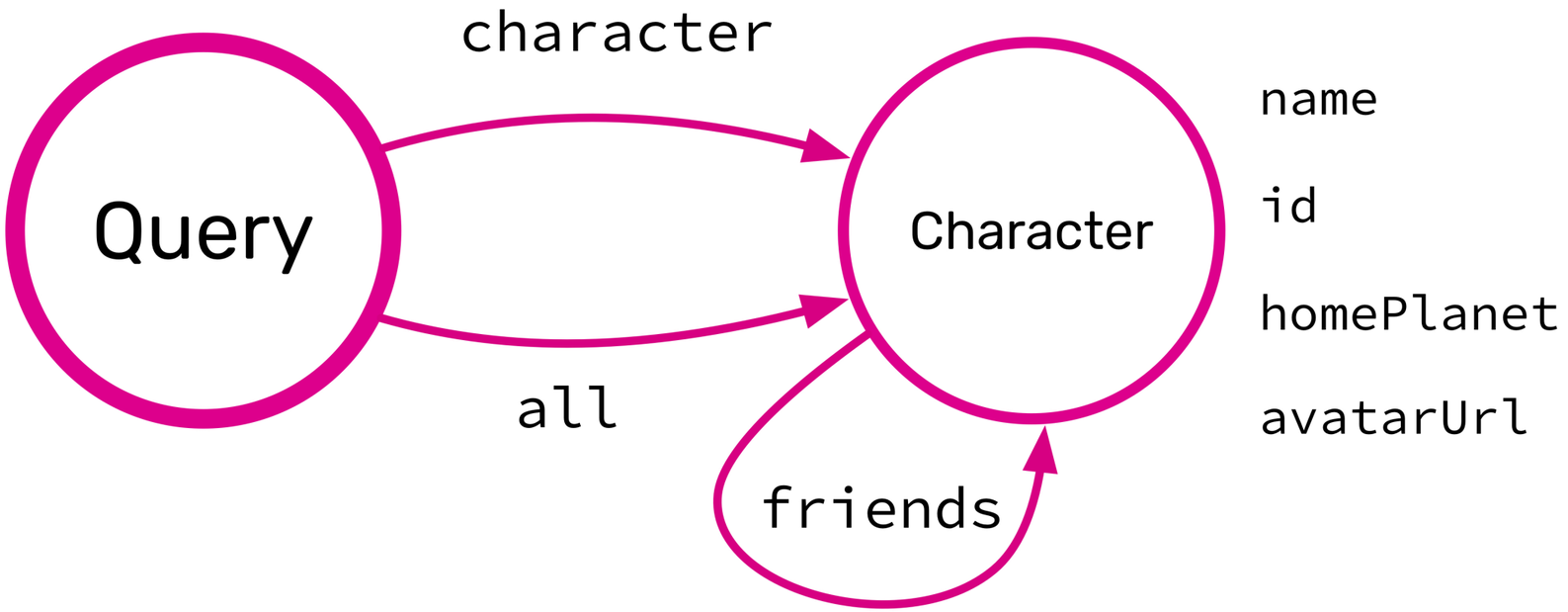


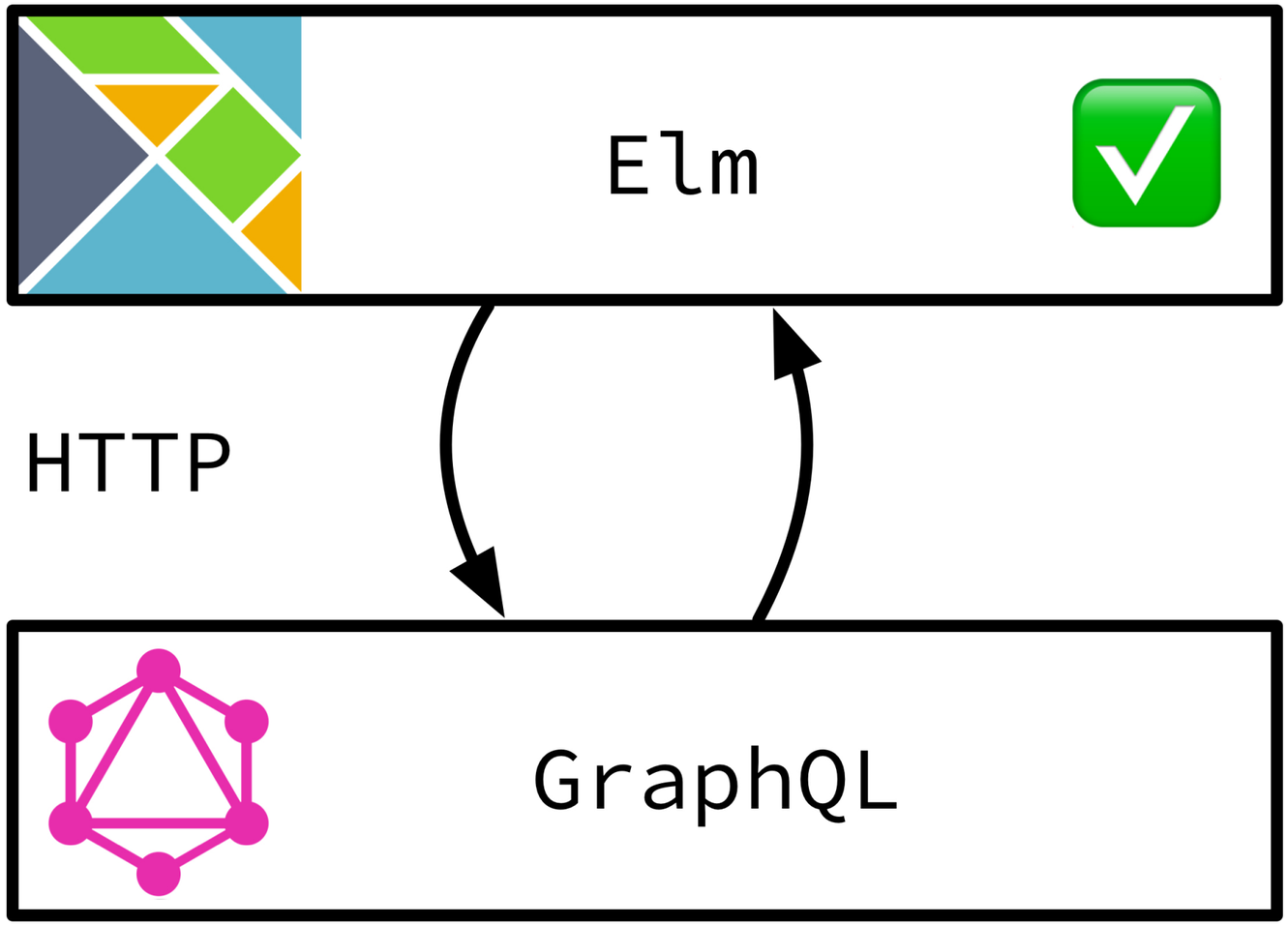
# GraphQL Arguments

```
type Query {
  character(id: ID!): Character
  all: [Character!]!
}
```


character
Query
Character
name
id
homePlanet
avatarUrl
all
friends




```
query {
  all {
    name
    avatarUrl
    homePlanet
    friends { name }
  }
}
```

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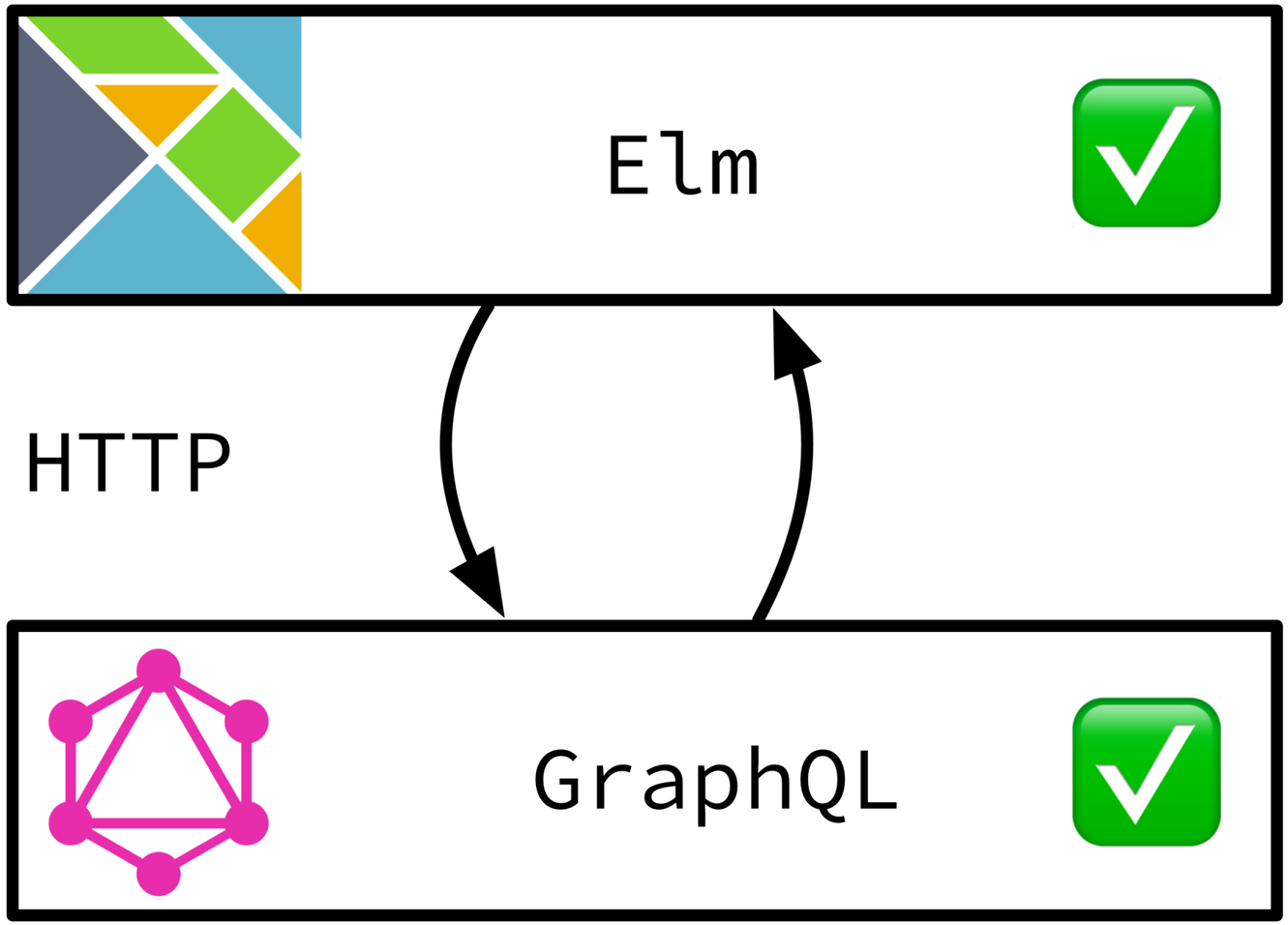


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# `dillonkearns/elm-graphql`

- **Generates a "hardcoded library"**
- `Json.Decode` **is an implementation detail**

# `dillonkearns/elm-graphql` **Guarantees**

- **Correct request**
- **Well-typed**
- **Decodes correctly**

# Json.Decode.Pipeline

```
type alias CharacterInfo =
  { name : String
  , avatarUrl : String
  , homePlanet : Maybe String
  }

characterDecoder =
  Decode.succeed CharacterInfo
    |> required "name" string
    |> required "avatarUrl" string
    |> required "homePlanet" (nullable string)
```

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# dillonkearns/elm-graphql

```
type alias CharacterInfo =
  { name : String
  , avatarUrl : String
  , homePlanet : Maybe String
  }

characterSelection =
  Character.selection CharacterInfo
    |> with Character.name
    |> with Character.avatarUrl
    |> with Character.homePlanet
```

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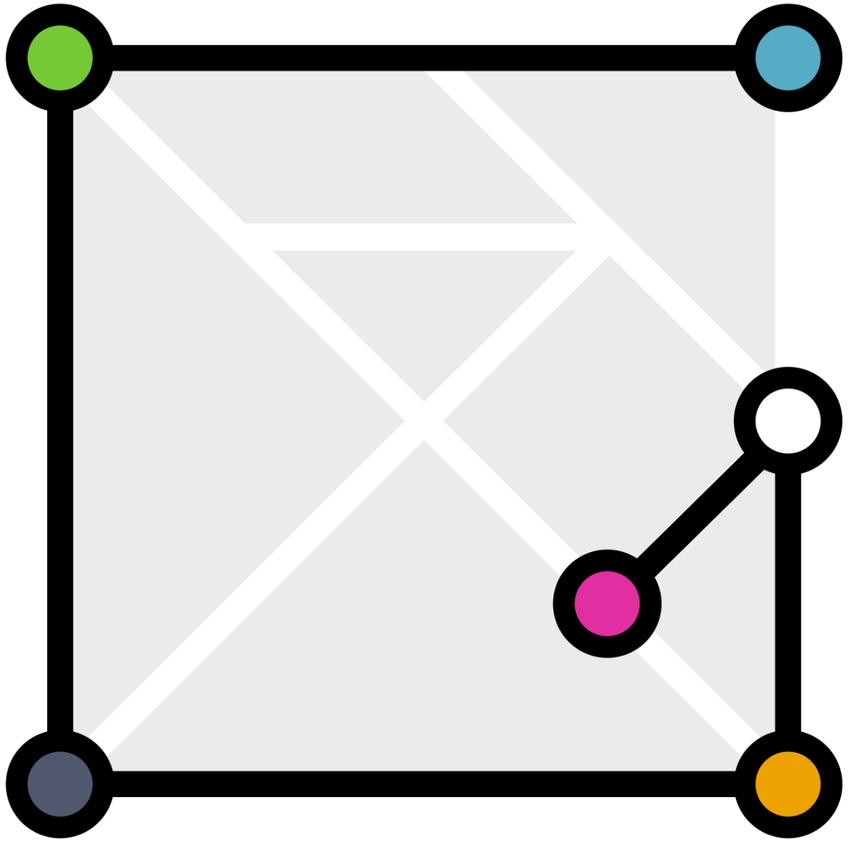
# Demo!

`dillonkearns/elm-graphql`



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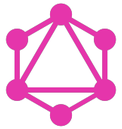
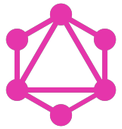


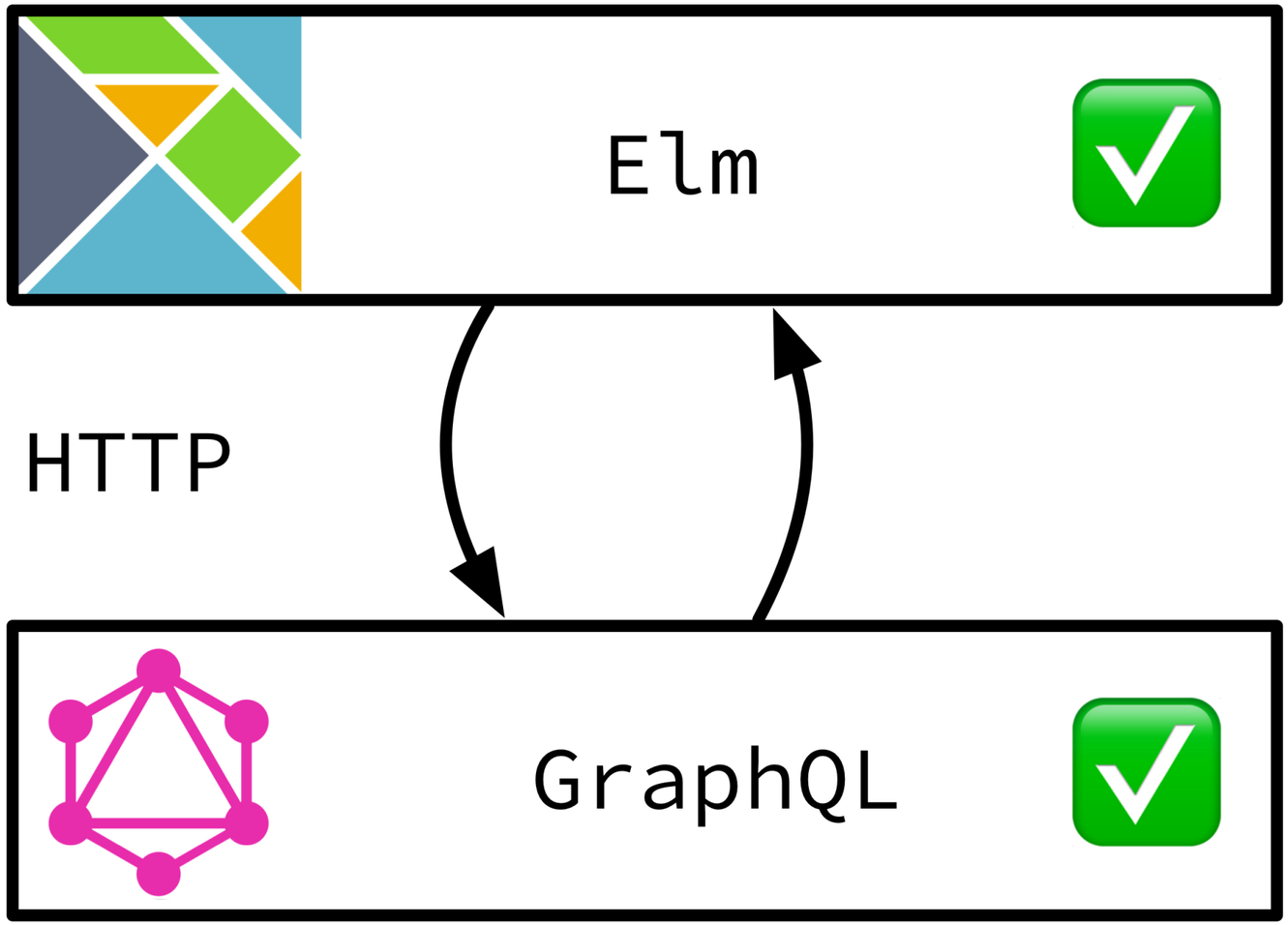
# Breaking Change

```
type Character {
  name: String!
  avatarUrl: String!
  homePlanet: String
}
```



# Breaking Change

```
type Character {
  name: String!
  -- avatarUrl: String!
  homePlanet: String
}
```

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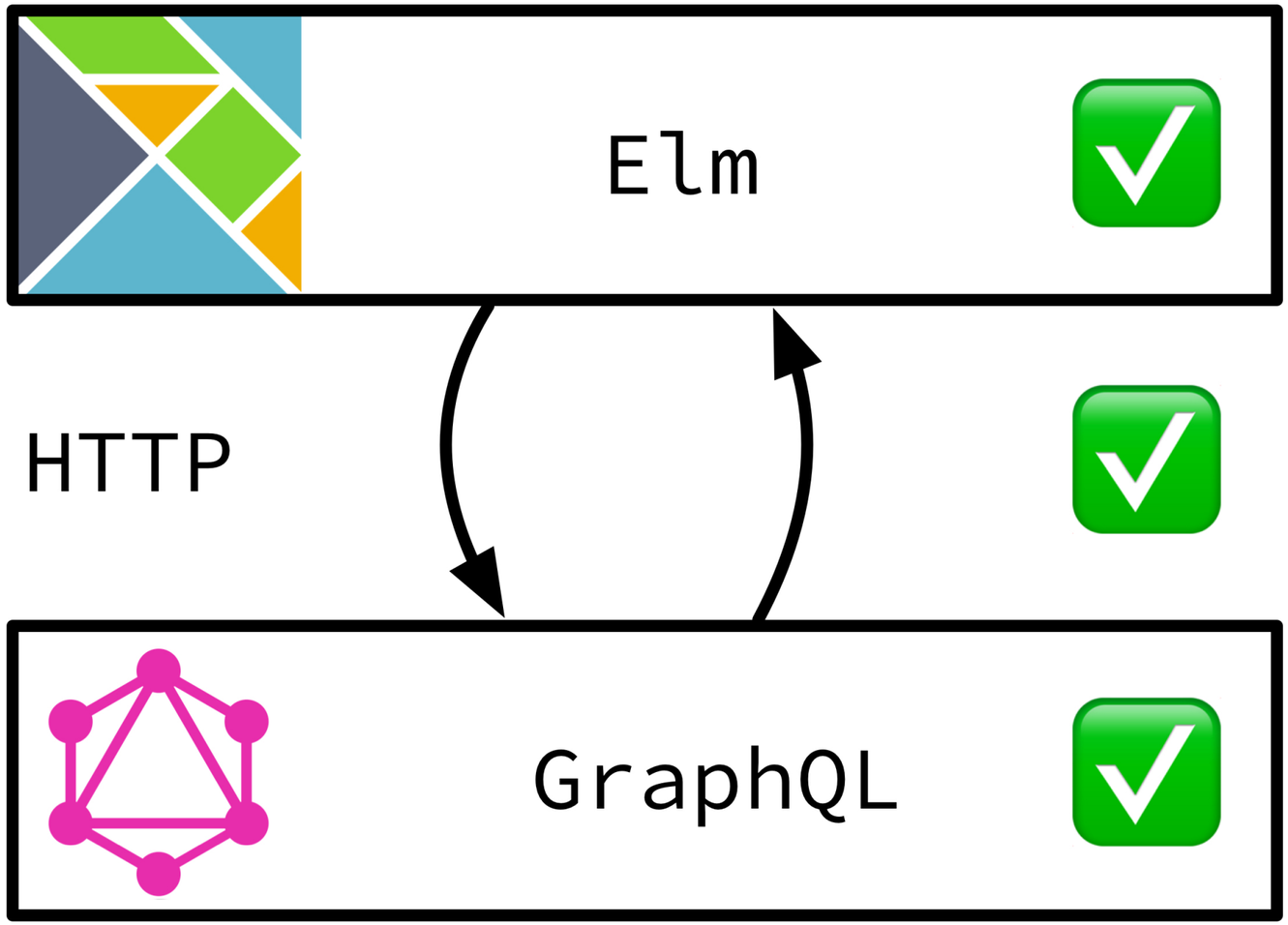


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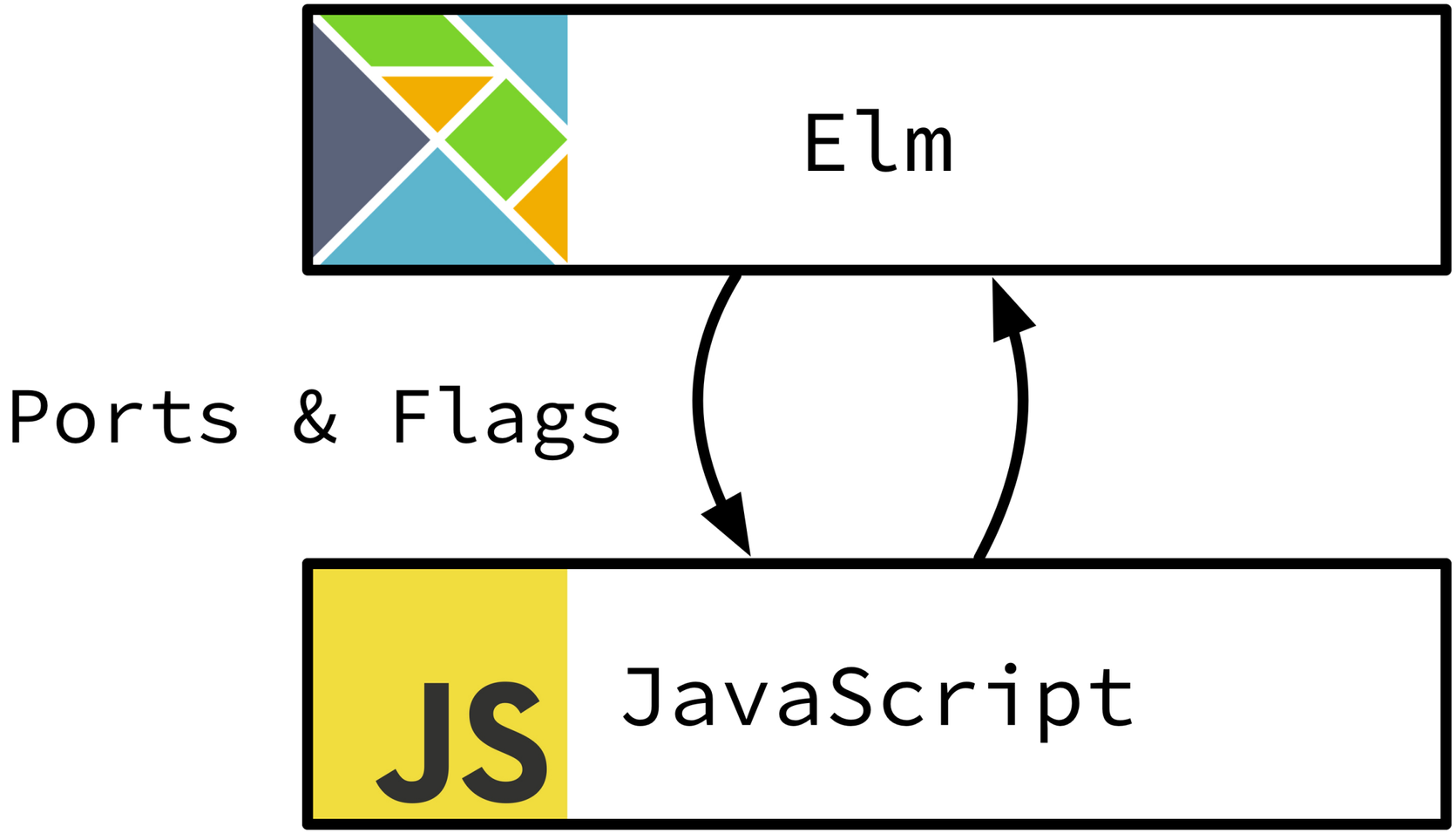


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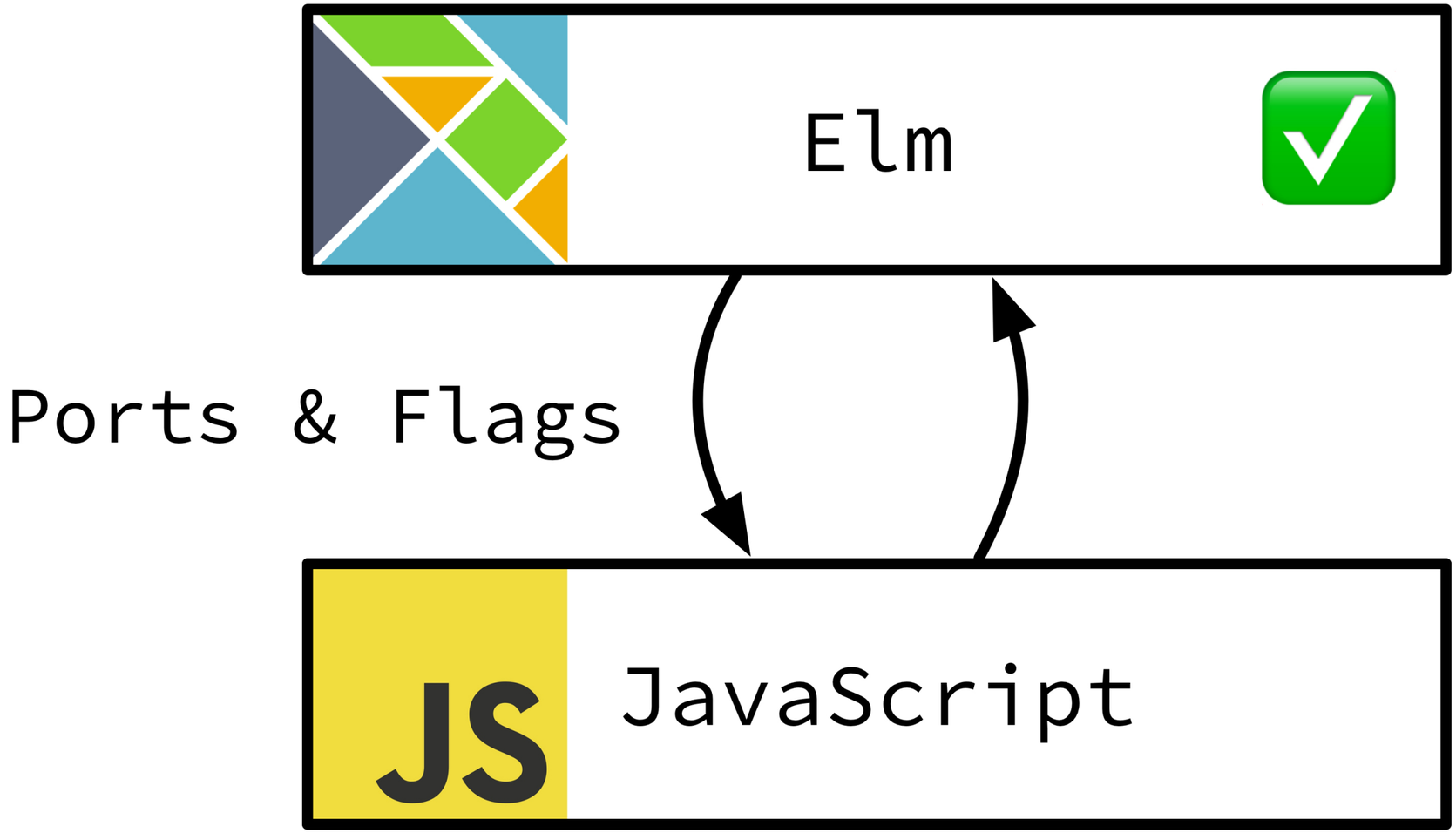


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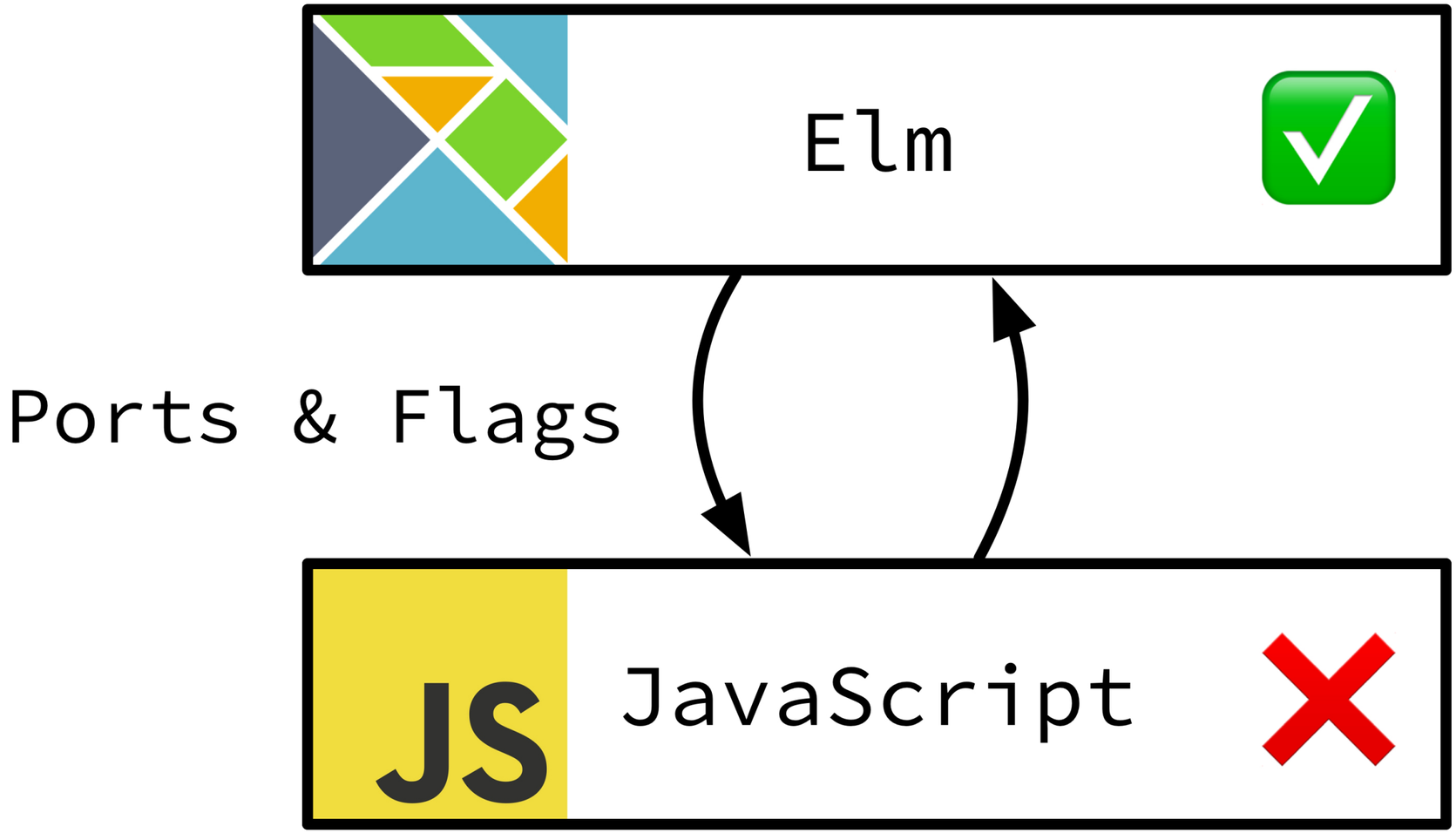


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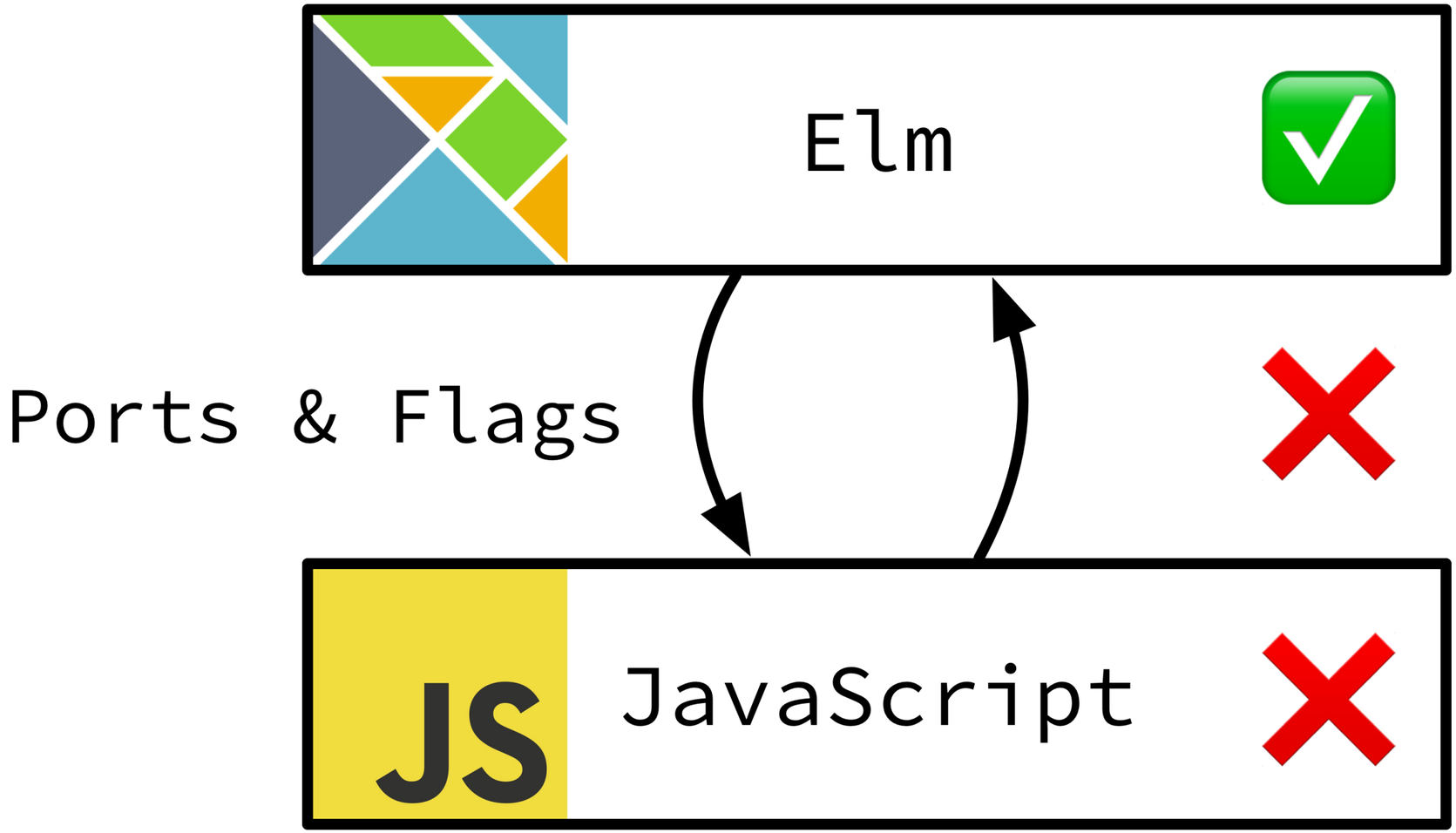


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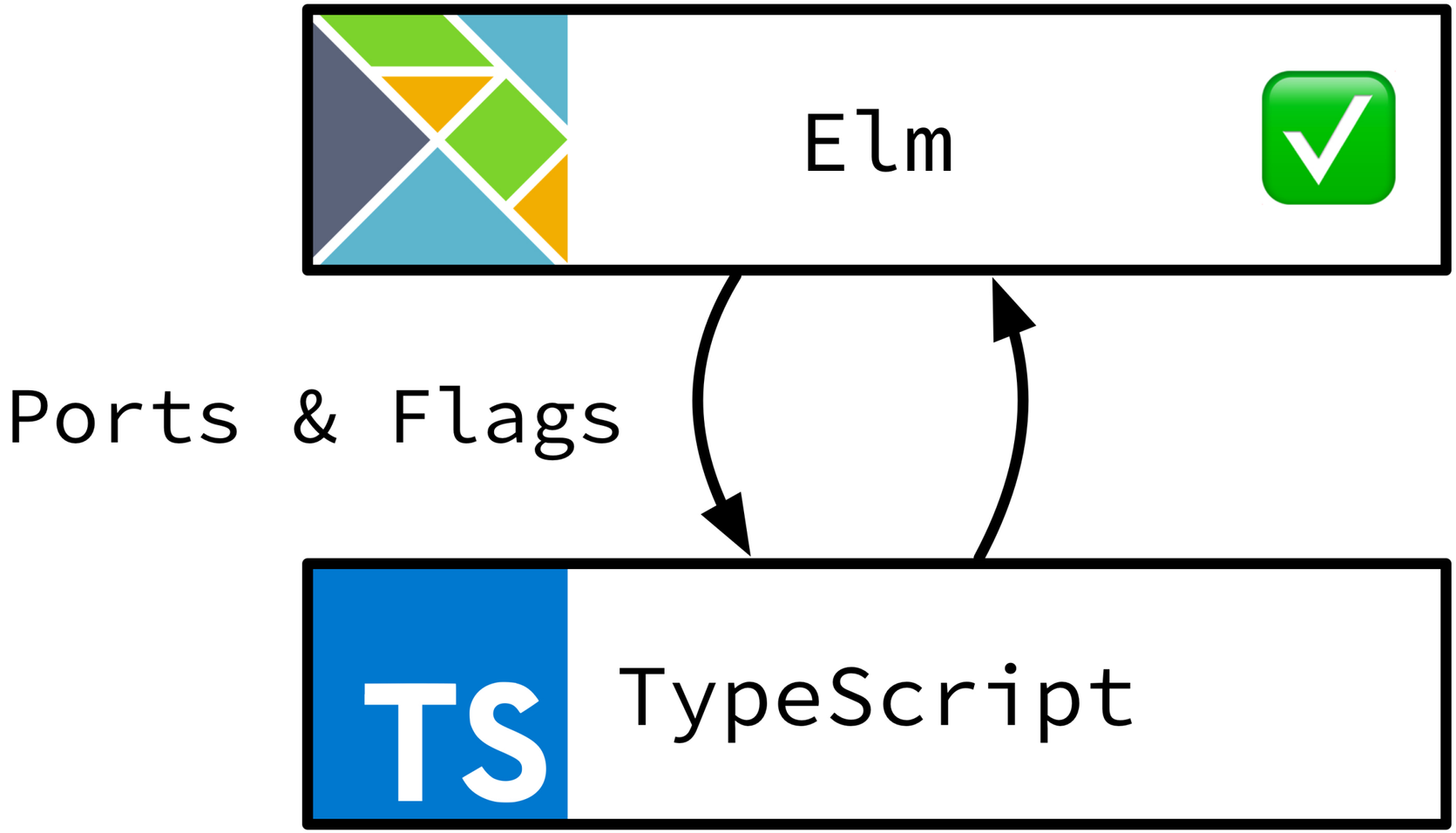


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# TypeScript

- Superset of JavaScript
- Editor integration, auto-complete
- Union Types
- Just add a `tsconfig.json`!

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```
npm install @types/<npm-library>
```

— **Often included (`electron`, `moment`)**

# Why Not Functional Compile-to-JS?

REASON

PURESCRIPT

— Avoid double-interop

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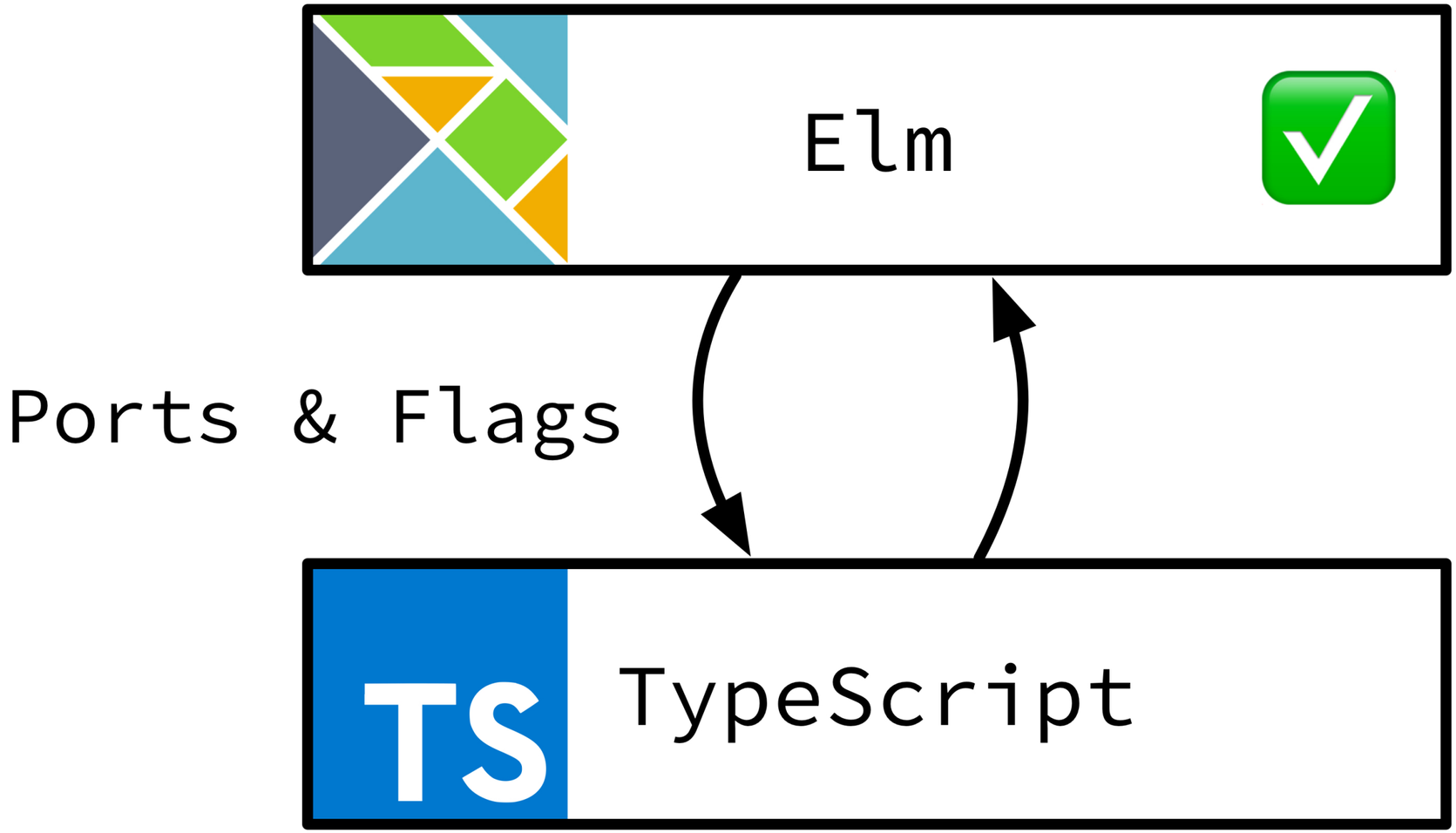


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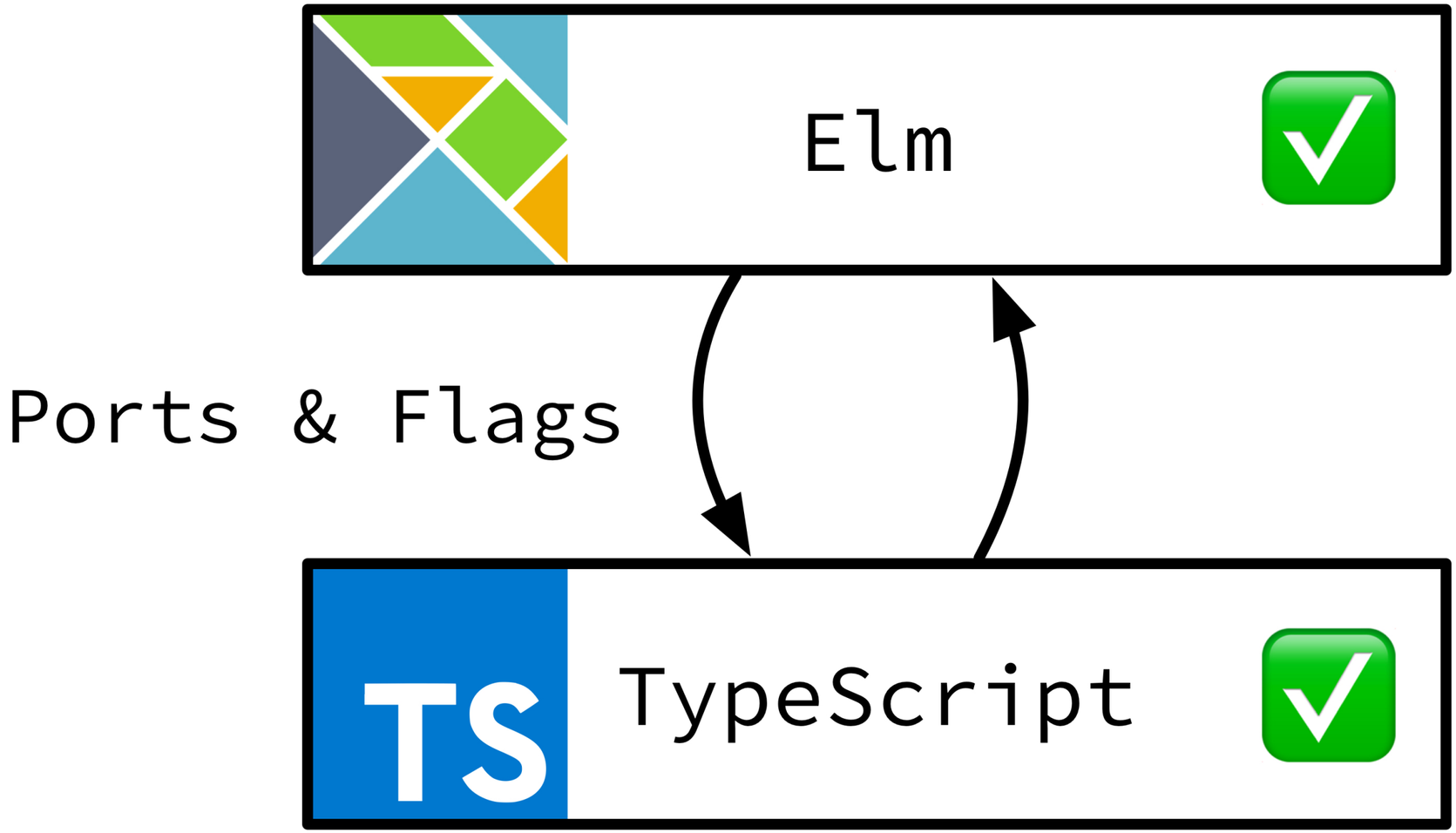


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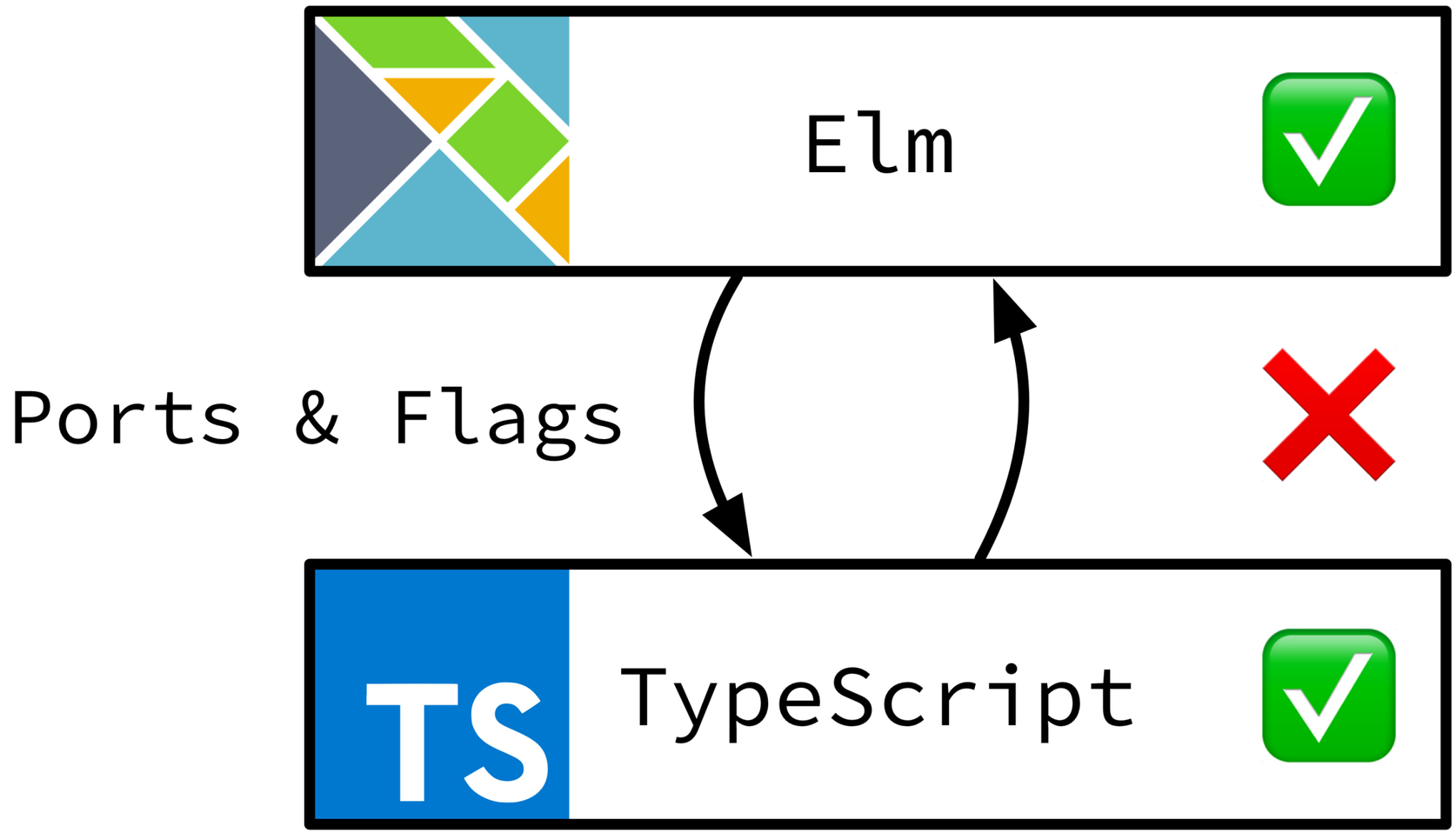


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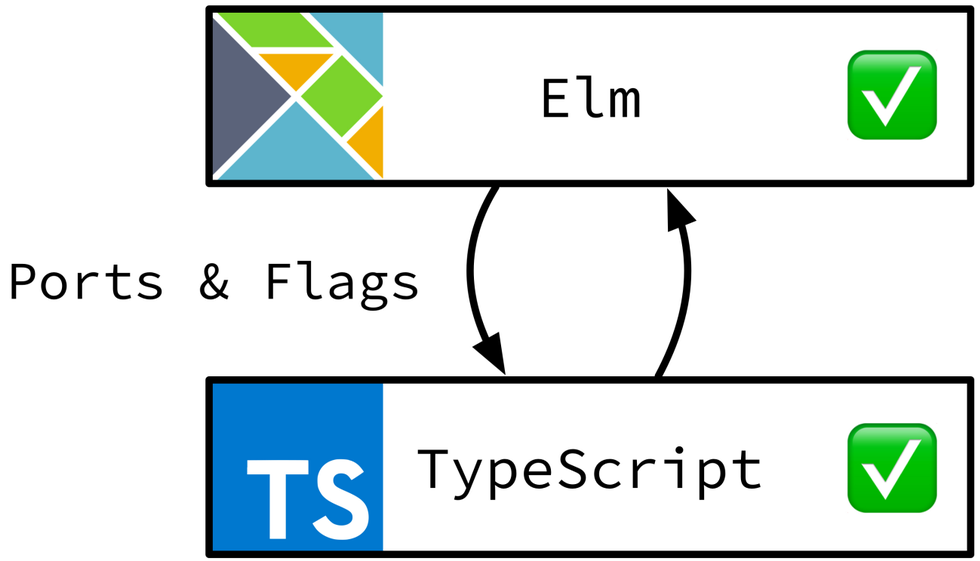
# Demo!

`elm-typescript-interop`

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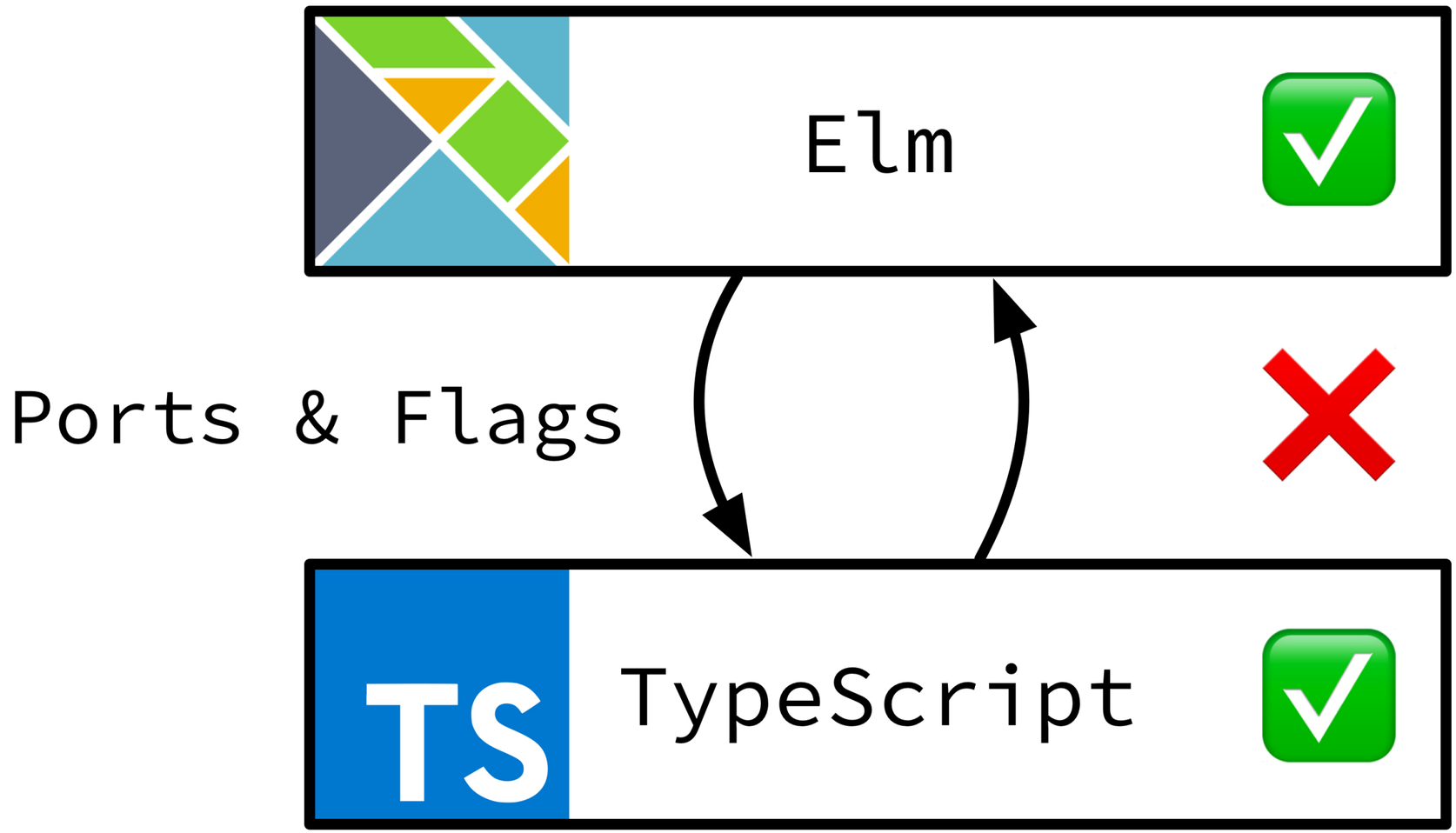


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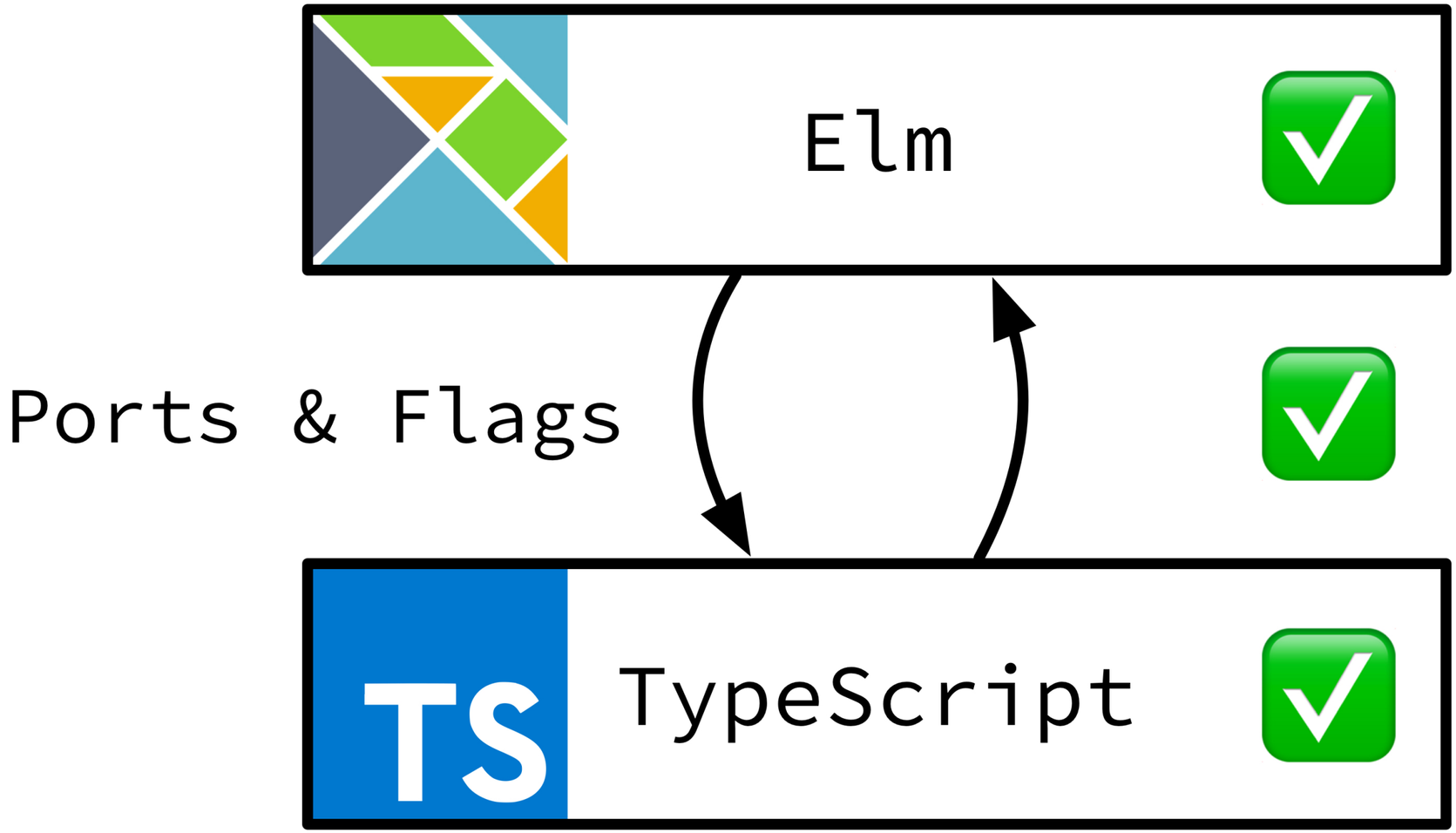


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# Variable Contracts

— APIs

— Databases/Storage 

— Message Passing  

— Any user-defined contract

# localStorage

localStorage

**Schema 1.0**

firstName: String!
lastName: String!

localStorage

**Schema 1.0**

firstName: String!
lastName: String!

firstName: "Jane"
lastName: "Doe"

localStorage

**Schema 1.0**

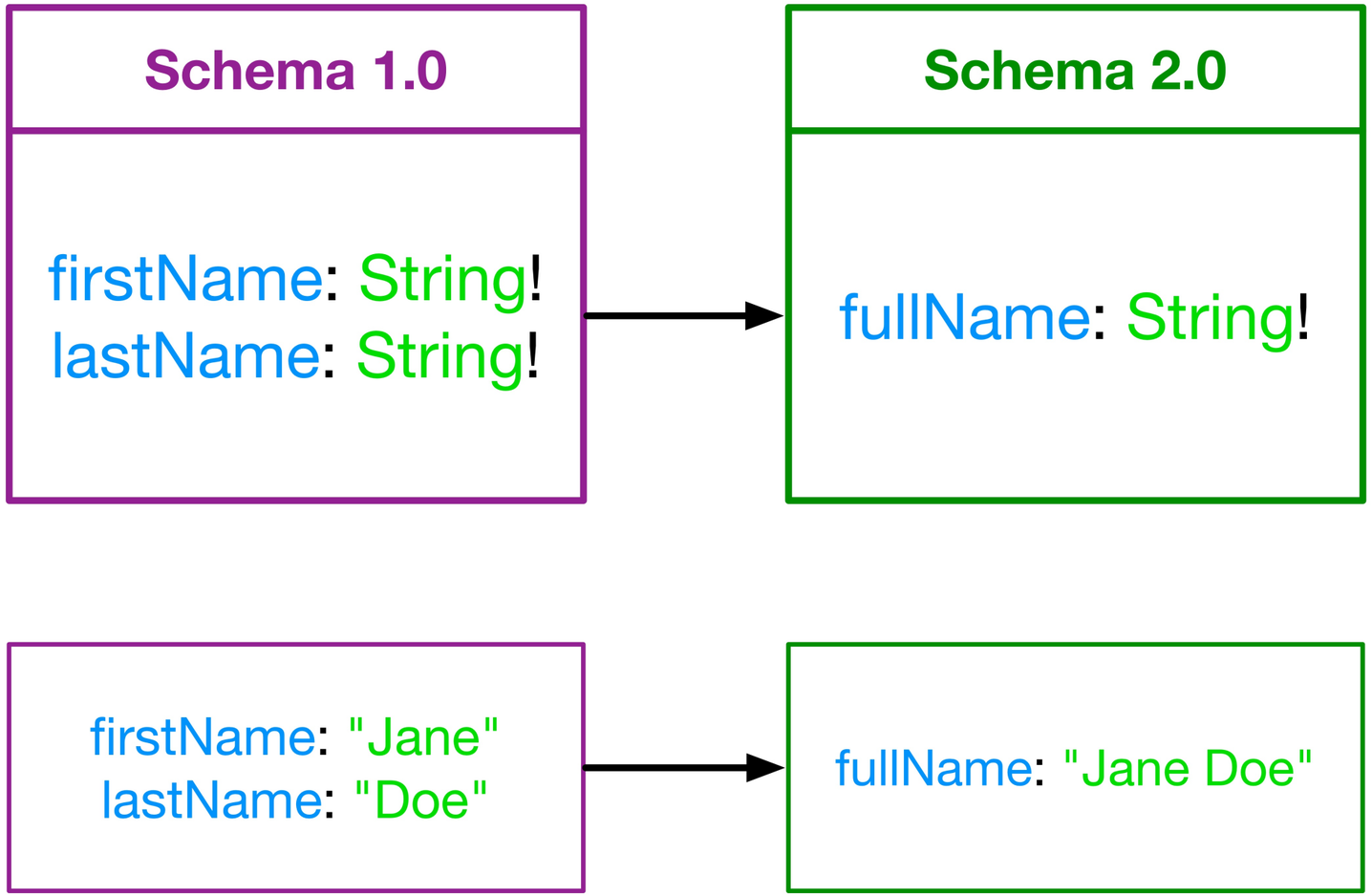
firstName: String!
lastName: String!

**Schema 2.0**

fullName: String!

firstName: "Jane"
lastName: "Doe"

localStorage

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# Sharing About Code Generation

— Code generation is more tedious than difficult
— Blog posts, talks
— End-to-end testing techniques
— Extract libraries

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# Representing Contracts in Elm

- Advanced Types posts - Charlie Koster (Opaque Types, Phantom Types)
- Making Impossible States Impossible - Richard
- Make Data Structures - Richard
- Scaling Elm Apps - Richard
- Understanding Style - Matt Griffith

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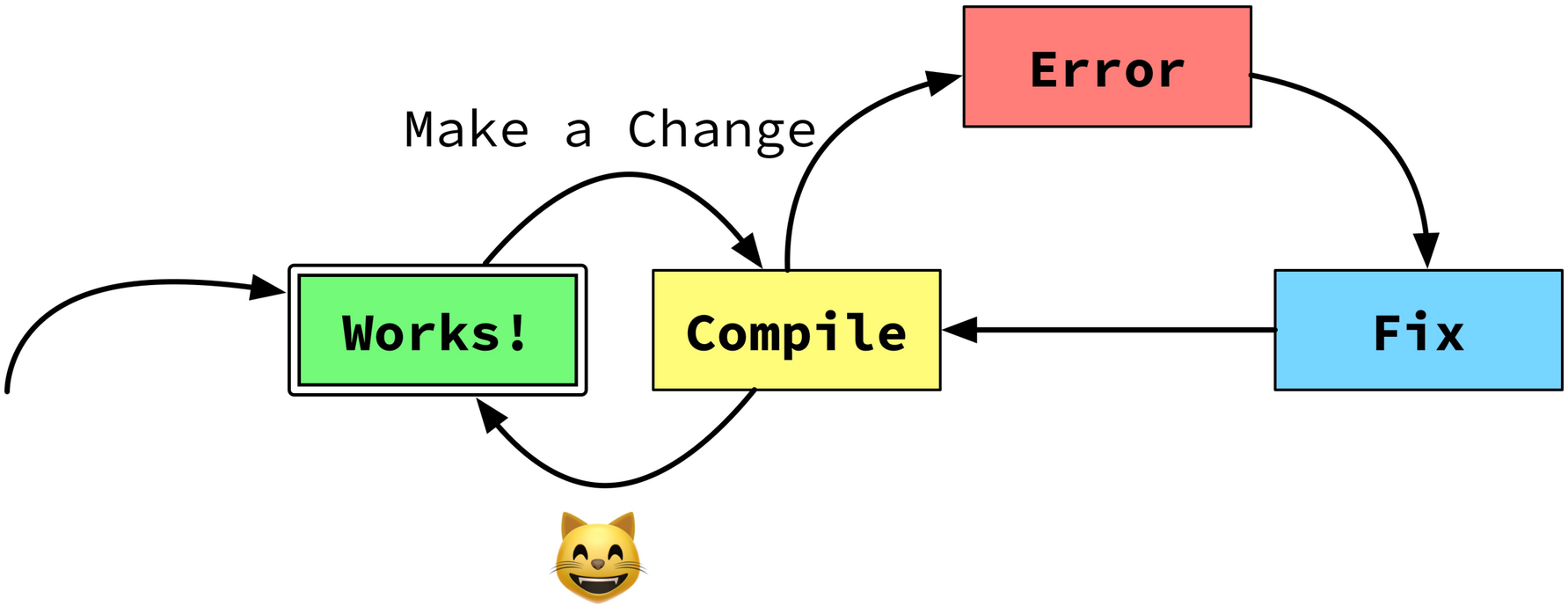
# Let's Eliminate Avoidable Uncertainty!

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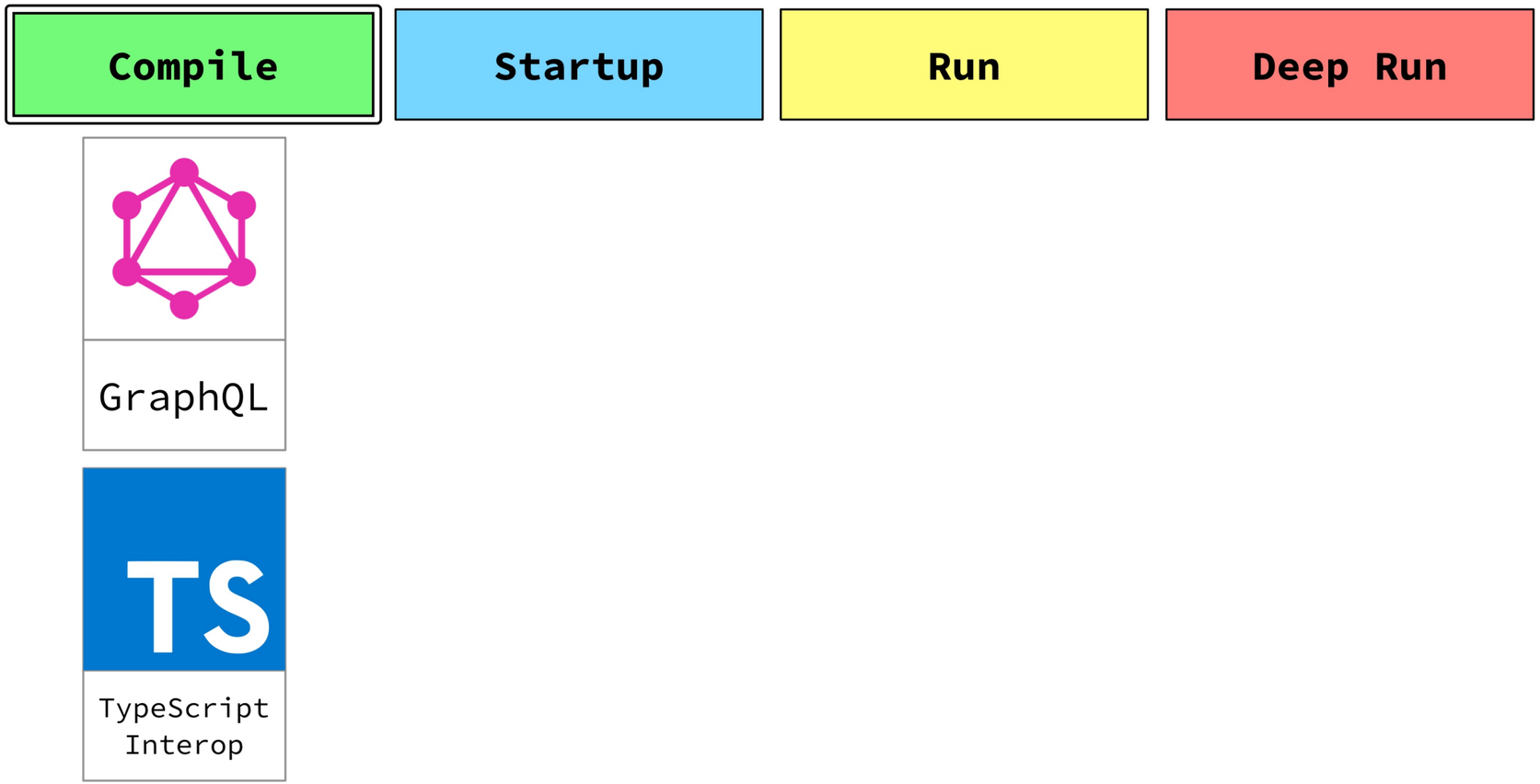
# Let's Be Certain Early!

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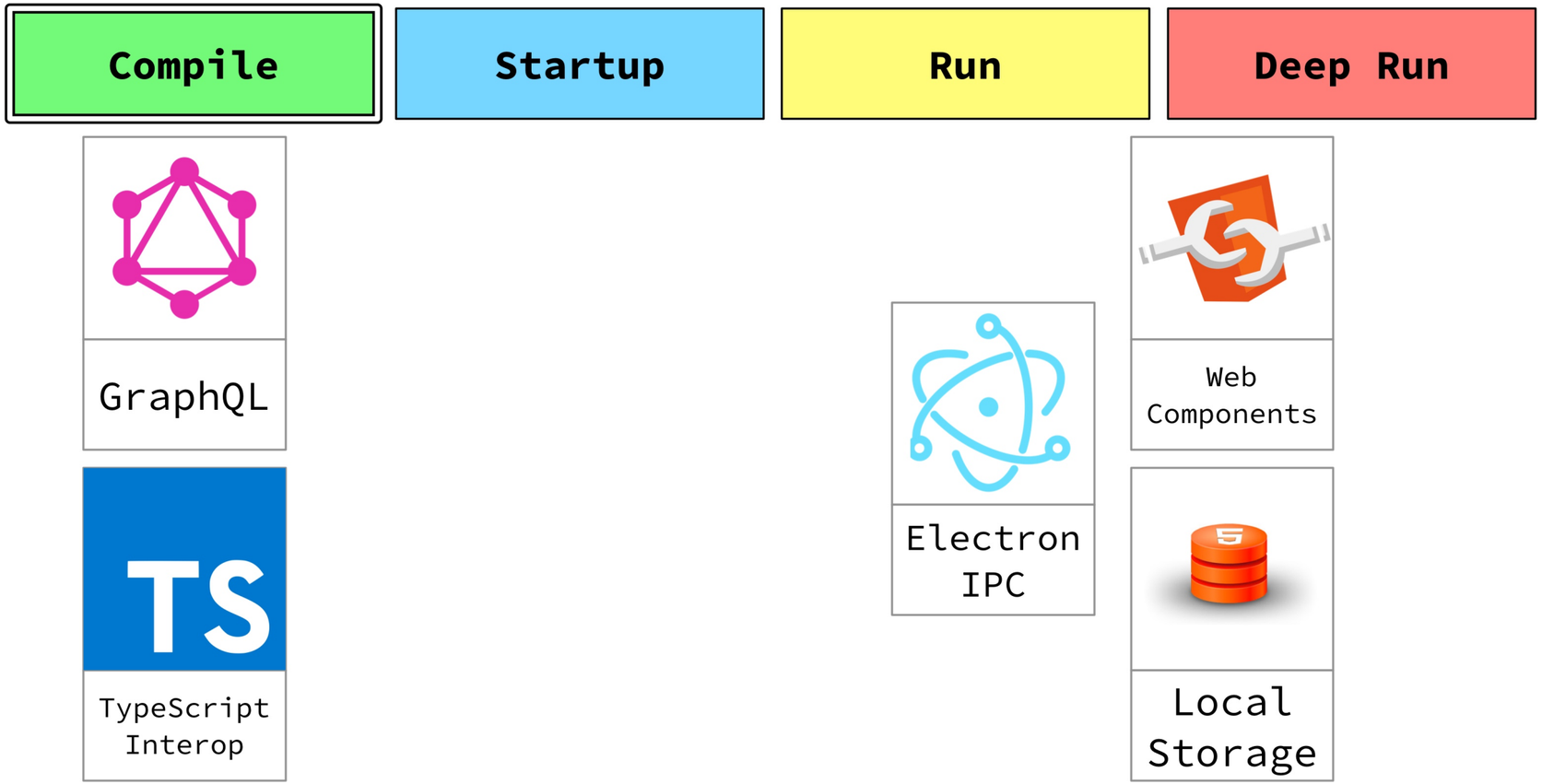
# Let's Be Certain Early!

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# #TypesWithoutBorders

What are your ideas?

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# Thank You!

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