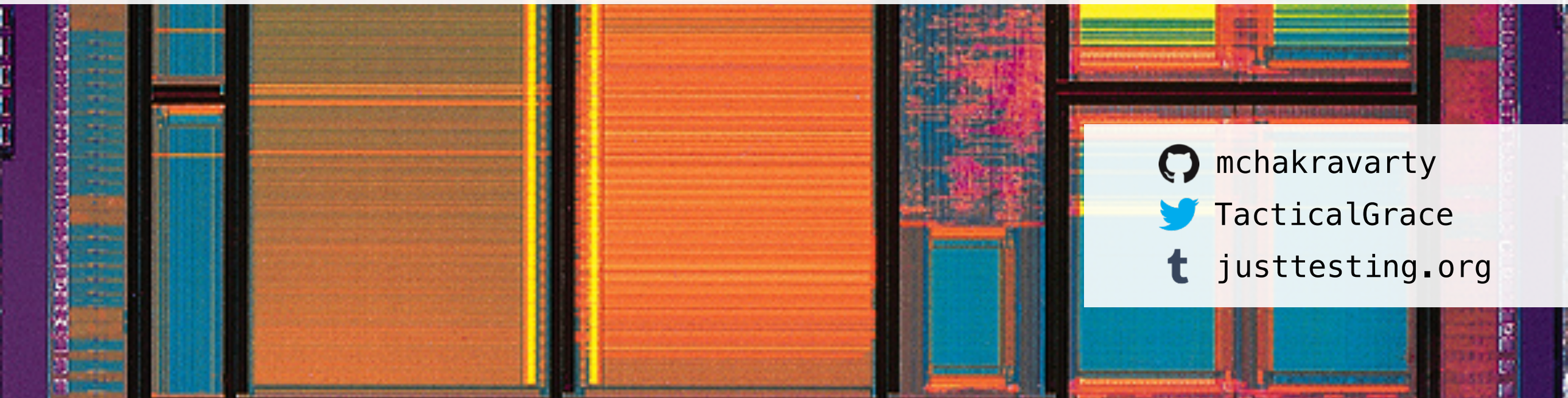
Functional Programming in a Stateful World

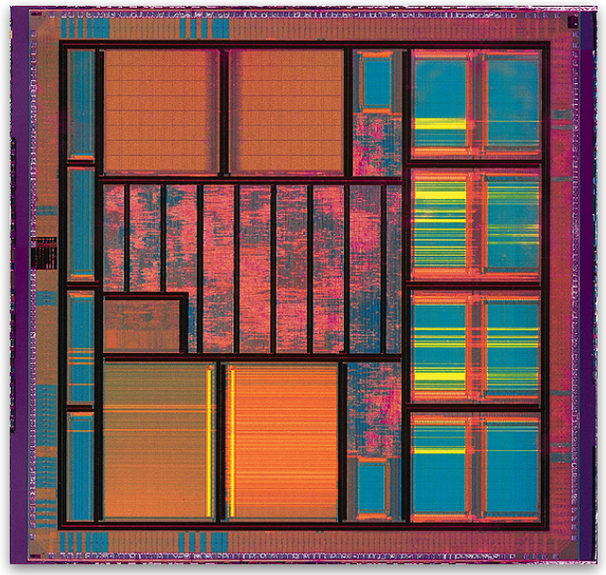
Manuel M T Chakravarty
Applicative &
Tweag I/O



Abstract

Abstract

Concrete



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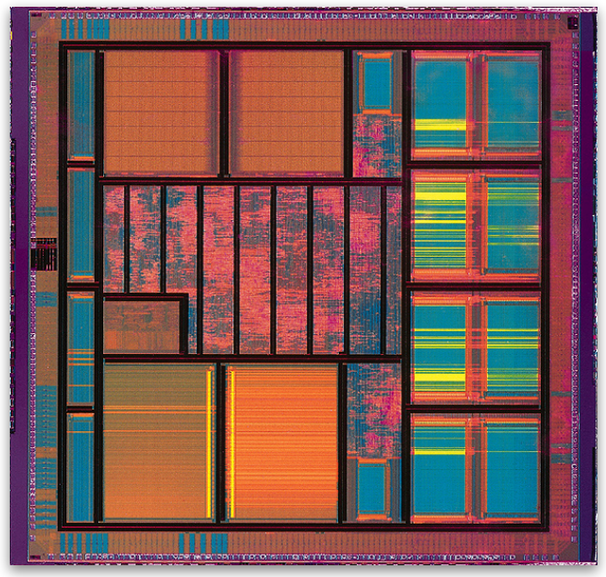

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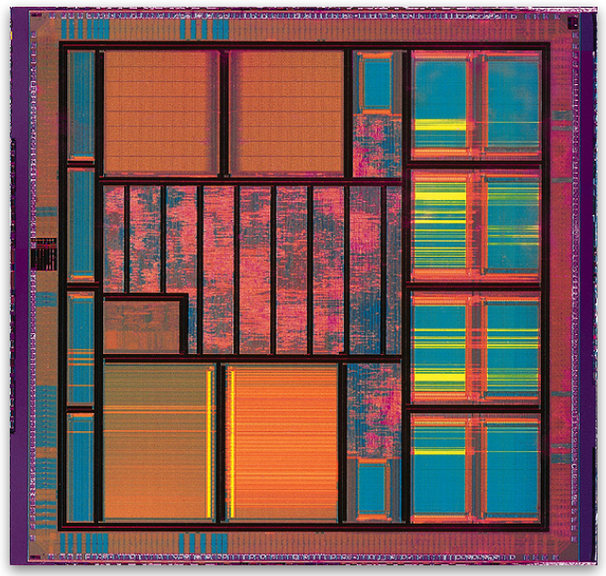
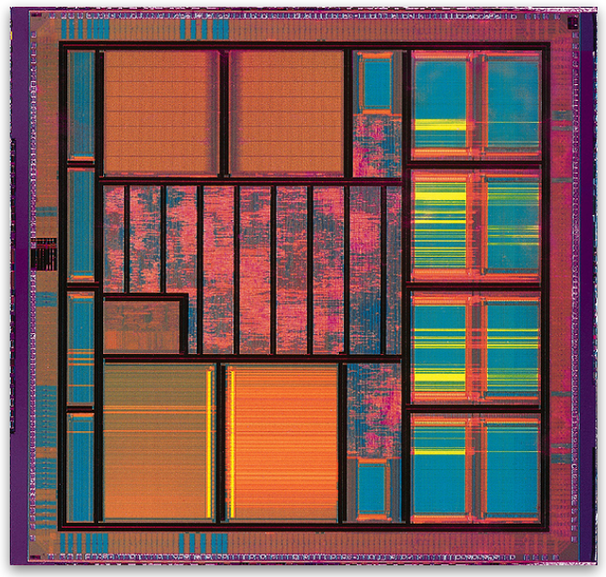


Entangled

Abstract

Concrete



Compositional

Entangled

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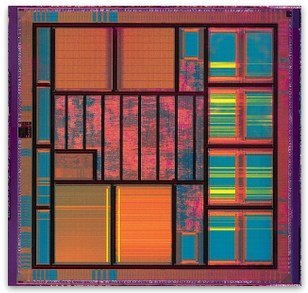
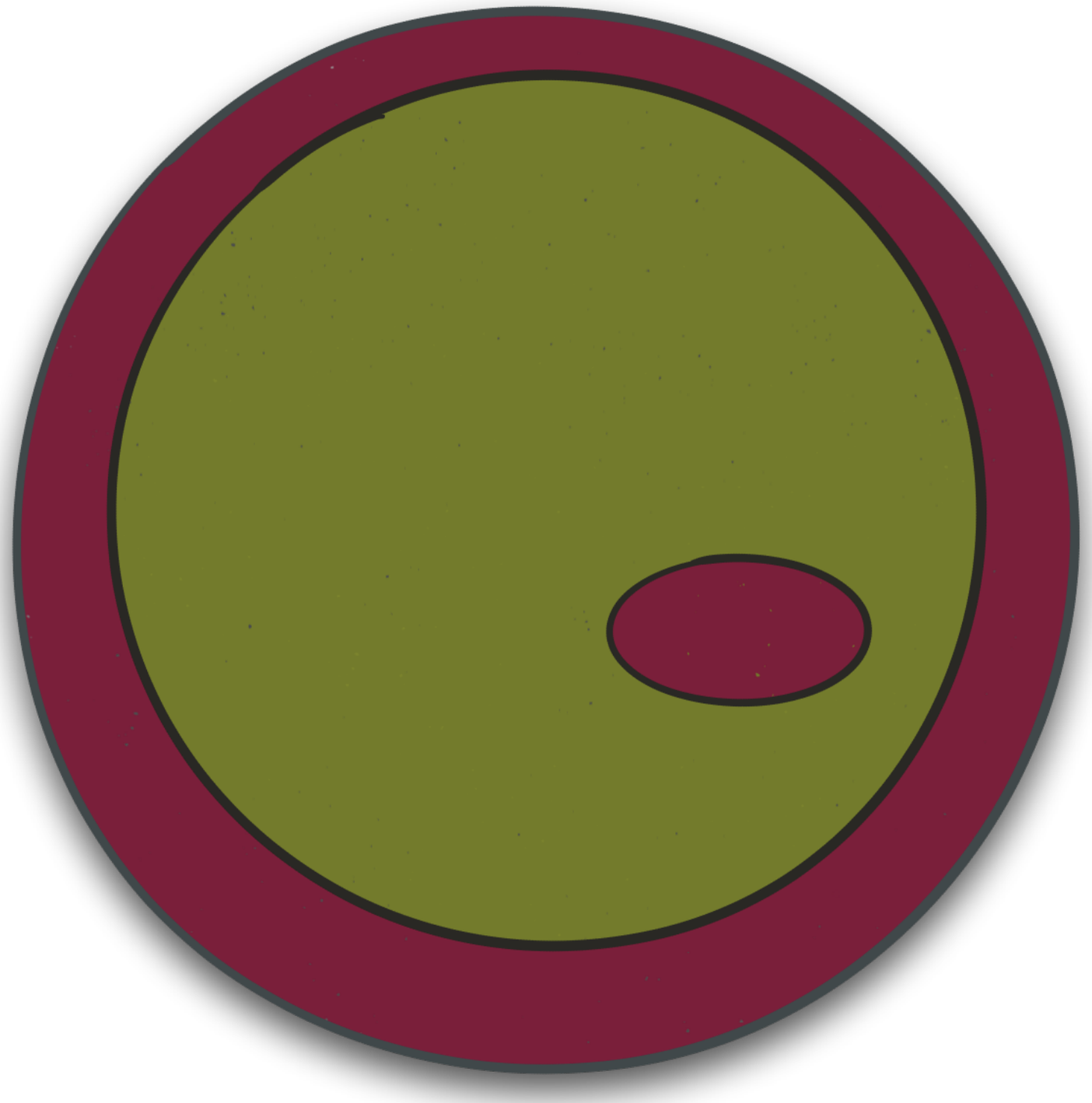


Compositional

Entangled

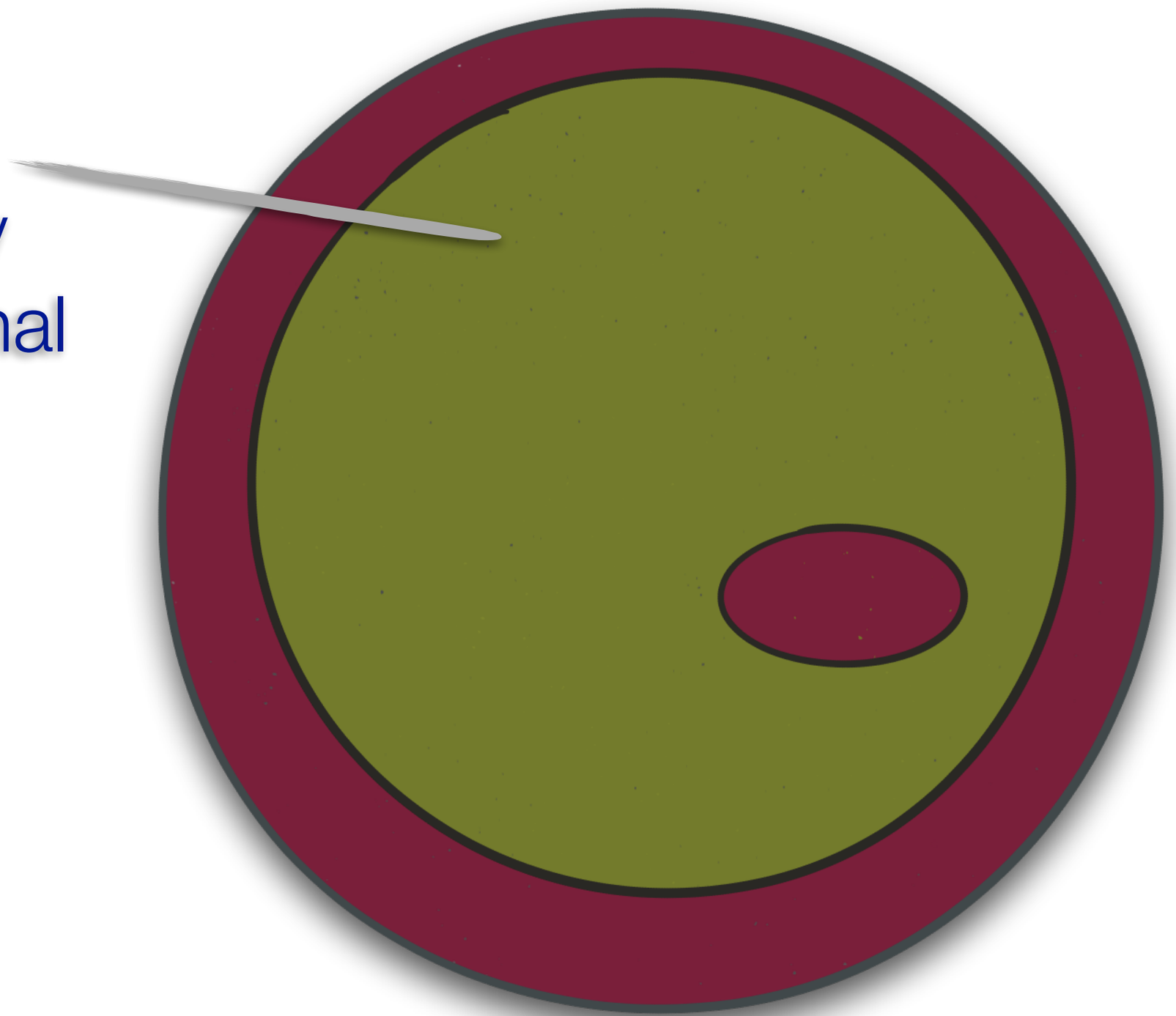
Anatomy of a Haskell Program



Anatomy of a Haskell Program

λ

purely functional core



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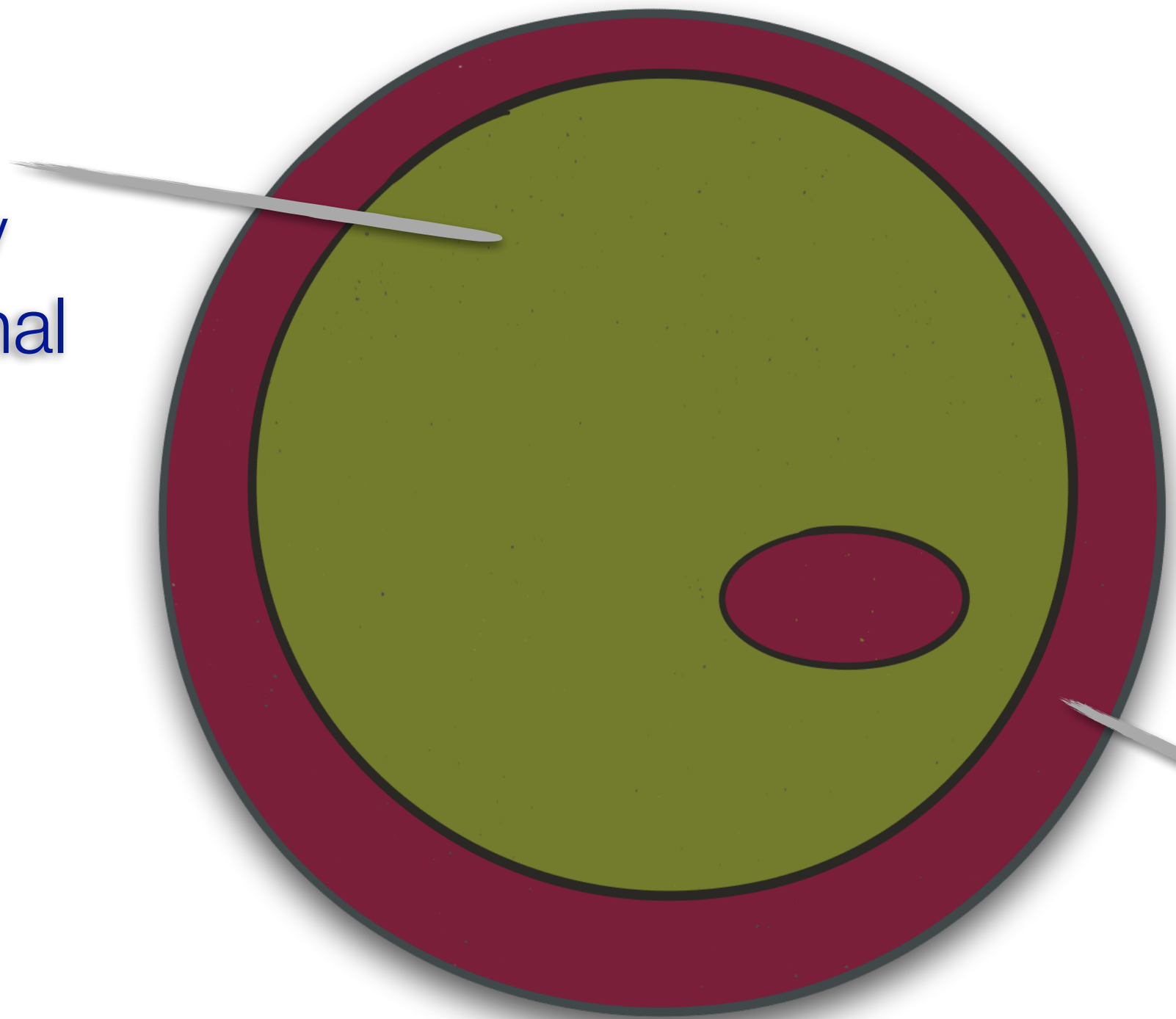

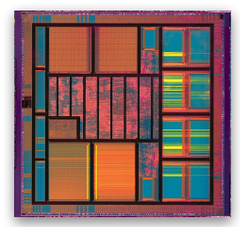

imperative shell

Anatomy of a Haskell Program

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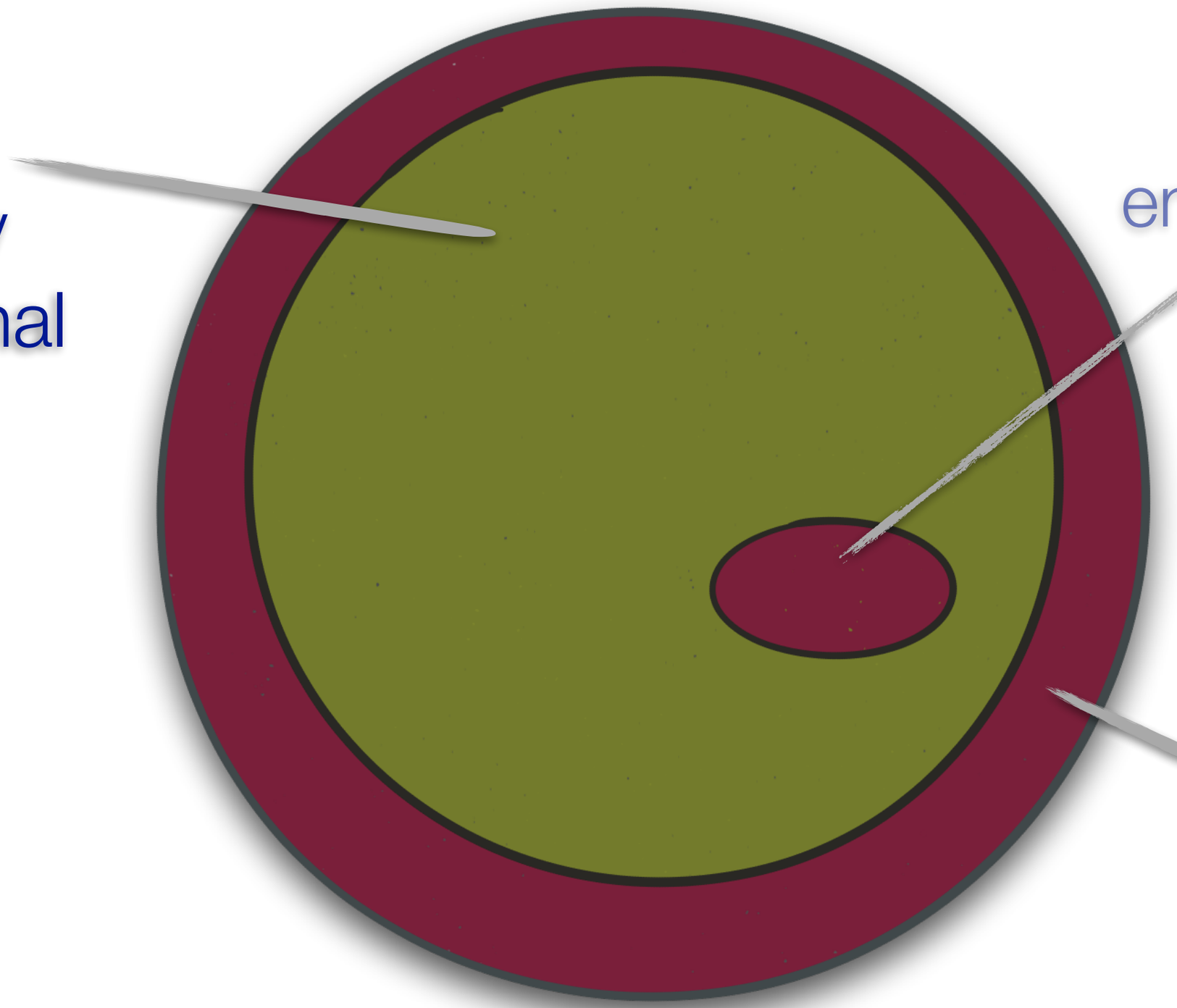
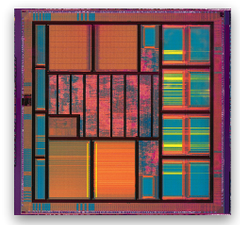
purely functional core



encapsulated state



imperative shell

Pipeline Applications

Pipeline Applications

Read request or data

Pipeline Applications

Read request or data

Compute

database

Pipeline Applications

Read request or data

Compute

database

Emit result

Pipeline Applications

Read request or data

Compute ..... database

Emit result

Server-side apps

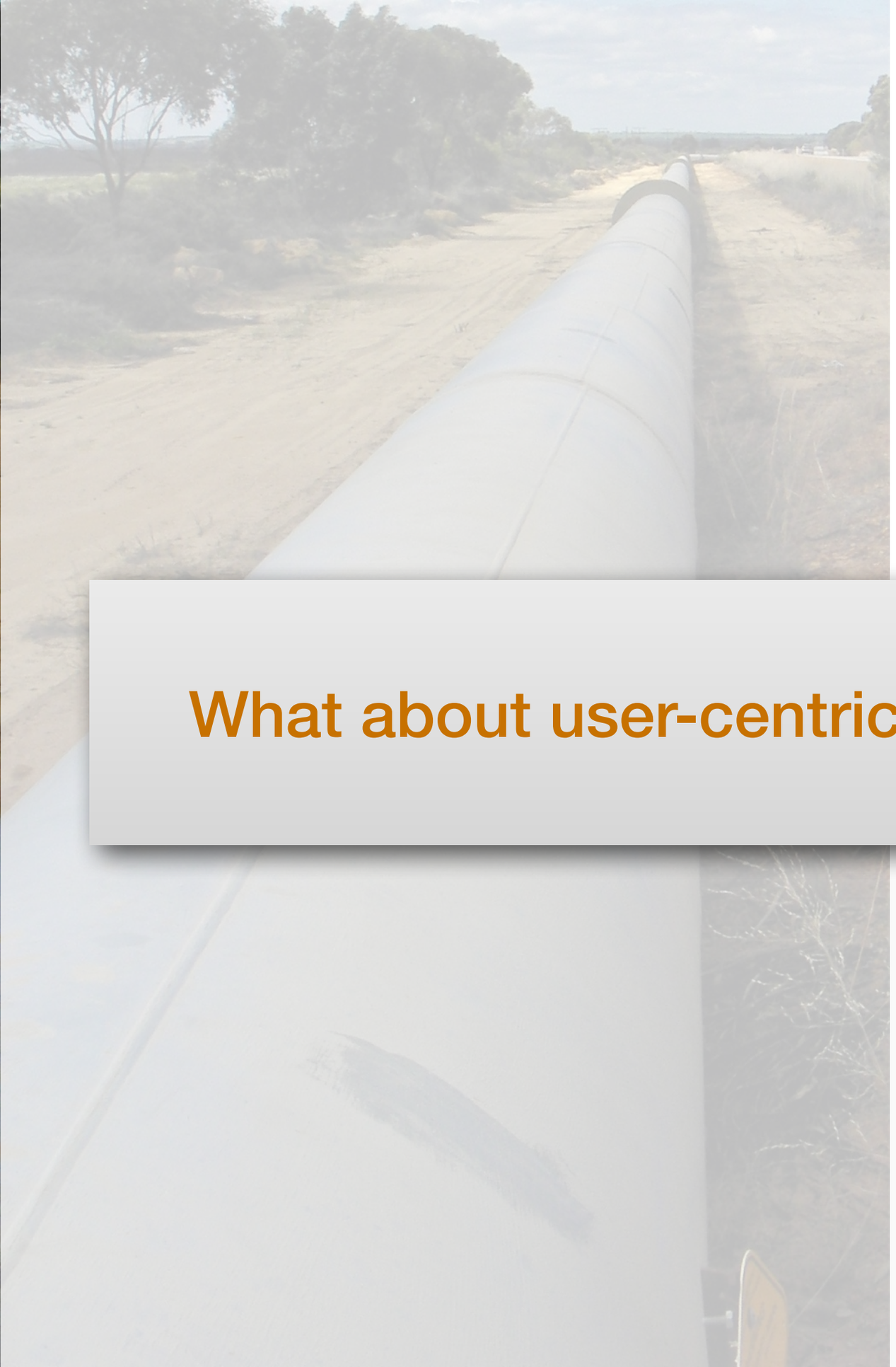
Command-line apps

Clojure

Haskell

OCaml

Scala



Pipeline Applications

Read request or data

Compute

database

What about user-centric & mobile applications?

Clojure

Haskell

Server-side apps

Command-line apps

OCaml

Scala

Swift

Swift

Swift

Can we extend the pipeline architecture?

GUI elements have their own derived state


Must use OO-based platform libraries
GUI elements have their own derived state

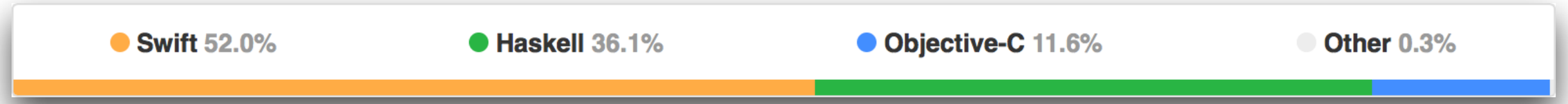

Frequent asynchronous events
Must use OO-based platform libraries
GUI elements have their own derived state

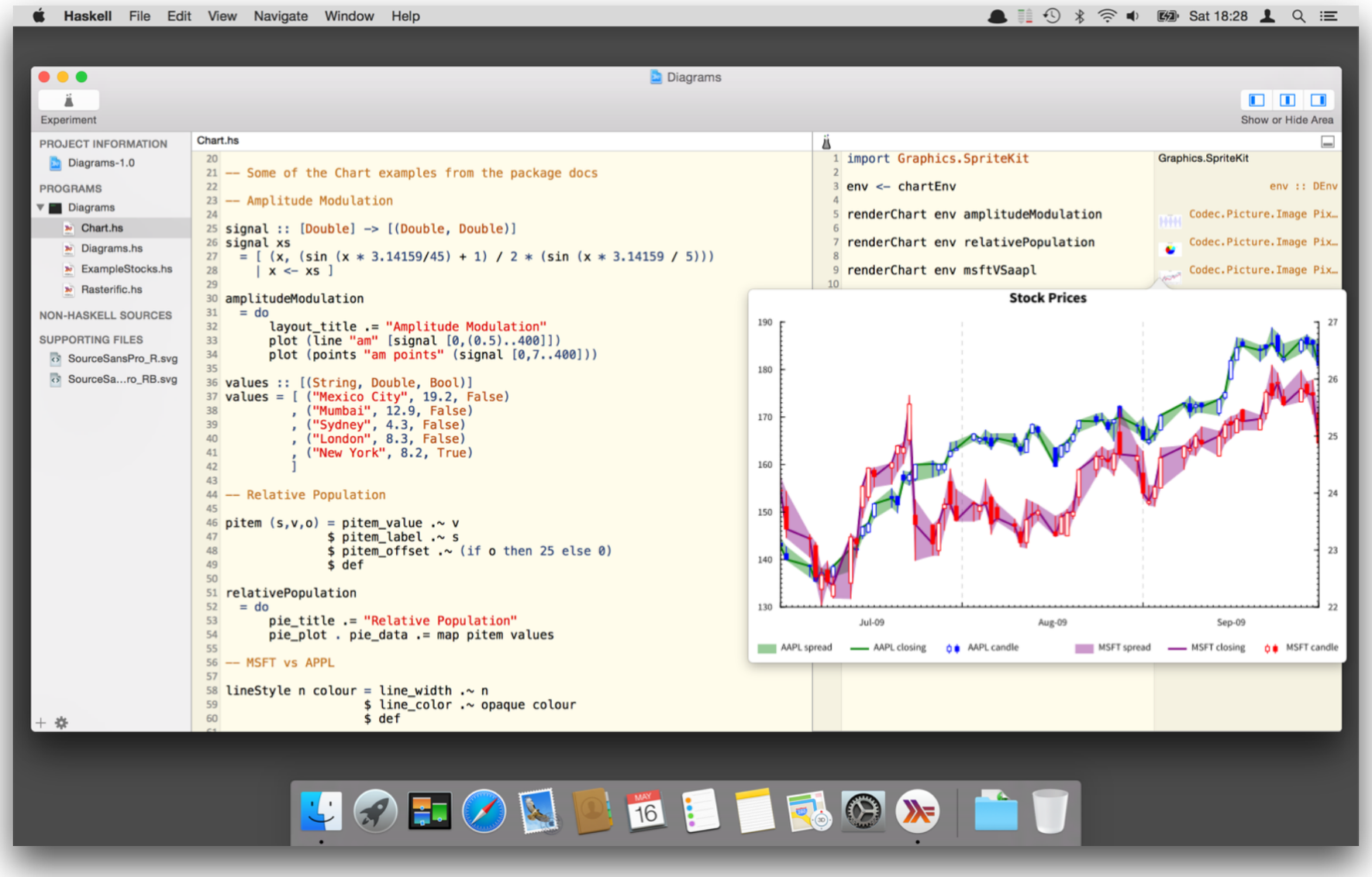

Must be responsive
Frequent asynchronous events
Must use OO-based platform libraries
GUI elements have their own derived state

“How can We Use Functional Programming in this context?”

A GUI-centric Mac app in Swift & Haskell

A GUI-centric Mac app in Swift & Haskell





Three Methods to Facilitate FP

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Application architecture

Isolate side effects with a view model

Three Methods to Facilitate FP

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Isolate side effects with a view model

Immutable values

Structs & enums over classes; and use let (not var)

Three Methods to Facilitate FP

Application architecture

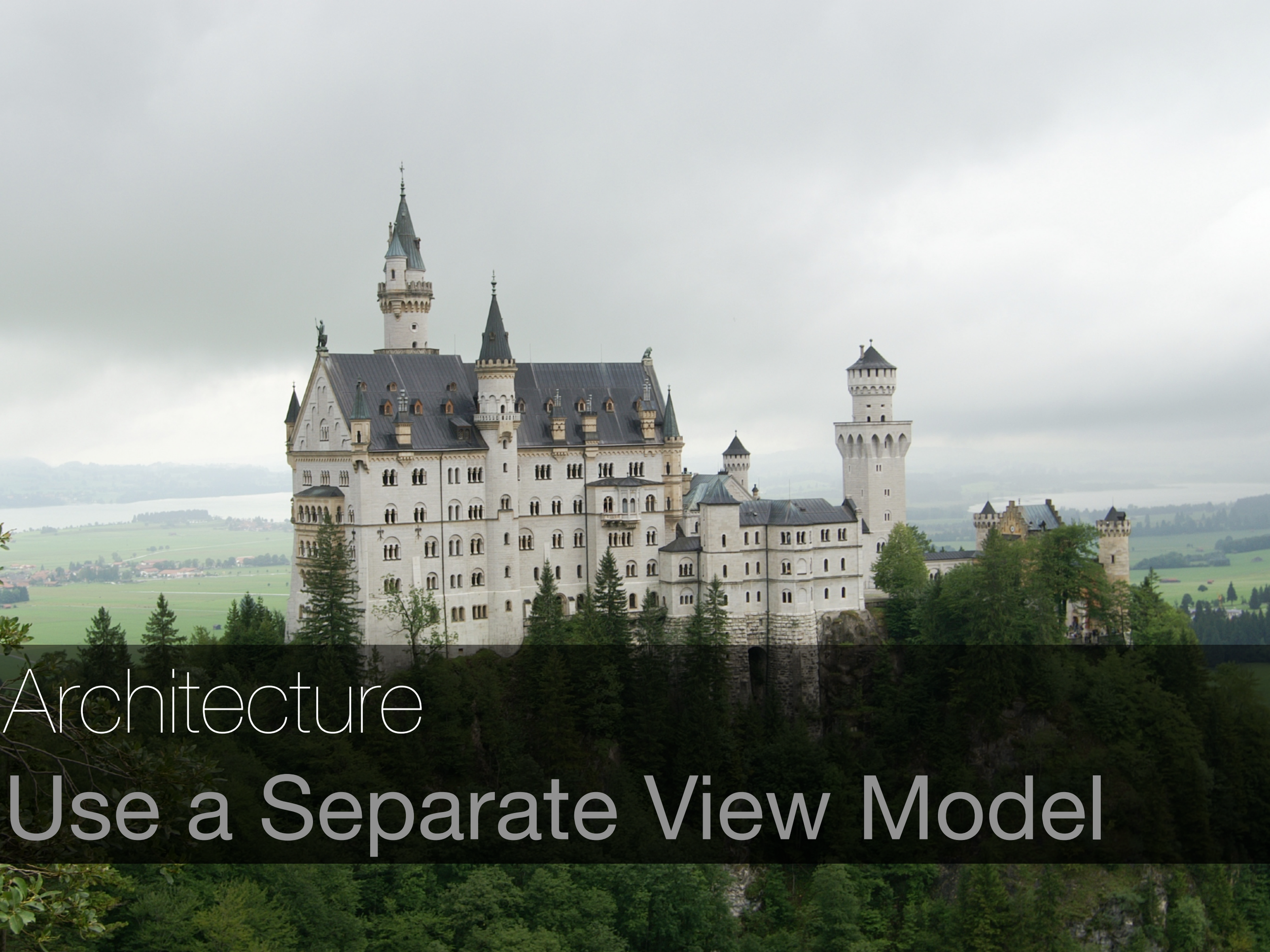
Isolate side effects with a view model

Immutable values

Structs & enums over classes; and use let (not var)

Time series

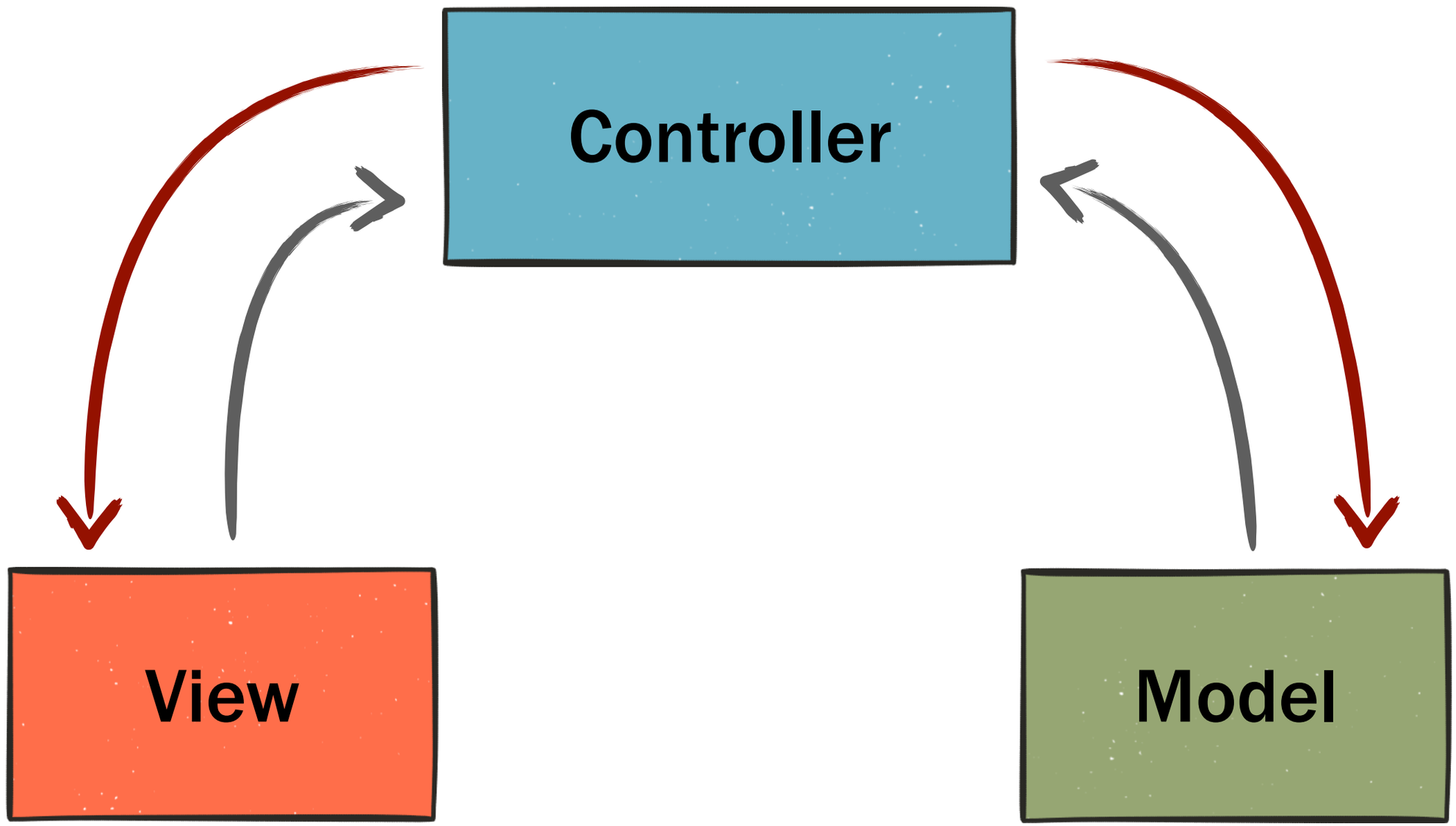
Streams of values over time replace mutable state



Architecture

Use a Separate View Model

What is a View Model?



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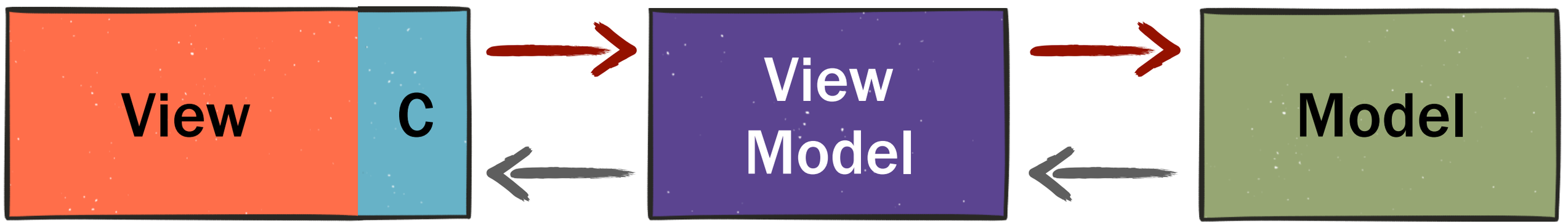

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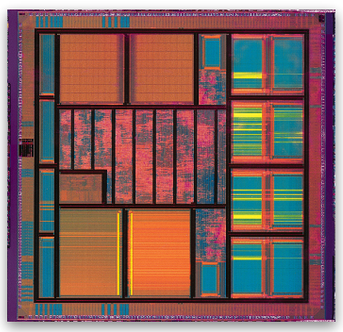

Mutable **Hybrid** **Immutable**

View | C → View Model → Model

Project Descriptions in Haskell for Mac

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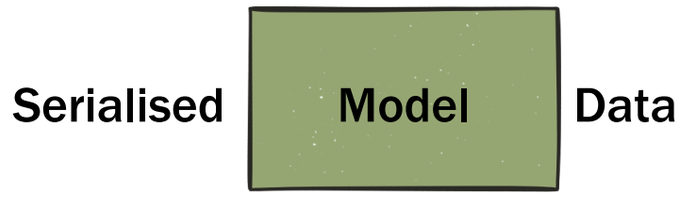


```
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version: 1.0
cabal-version: 1.6
build-type: Simple
license: BSD3
license-file: ""
copyright: Copyright 2015 Manuel M T Chakravarty
maintainer:
build-depends:
stability: experimental
homepage:
package-url:
bug-reports:
synopsis: Demonstrate the use of the Diagrams et
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description: This project demonstrates the use
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in Haskell for Mac's interactive playgrounds.
category: Sample project
author: Manuel M T Chakravarty
tested-with:
data-files: SourceSansPro_R.svg
SourceSansPro_RB.svg
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extra-source-files:
Executable Diagrams
  main-is: Diagrams.hs
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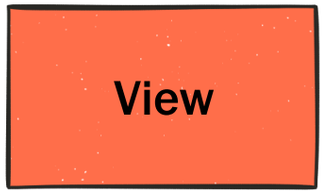
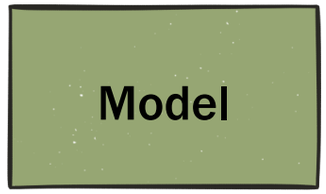
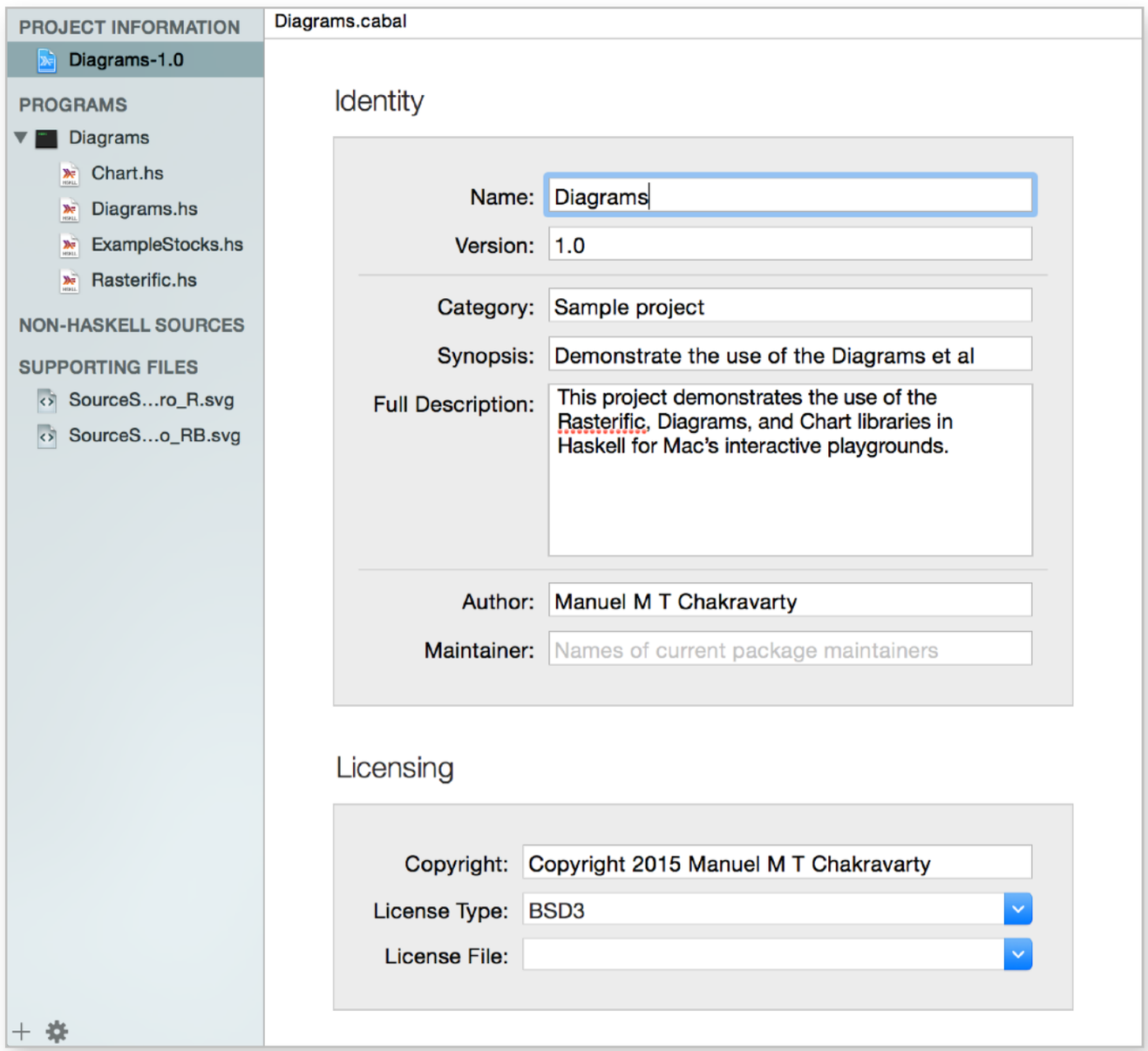
Project Descriptions in Haskell for Mac



Serialised  Data

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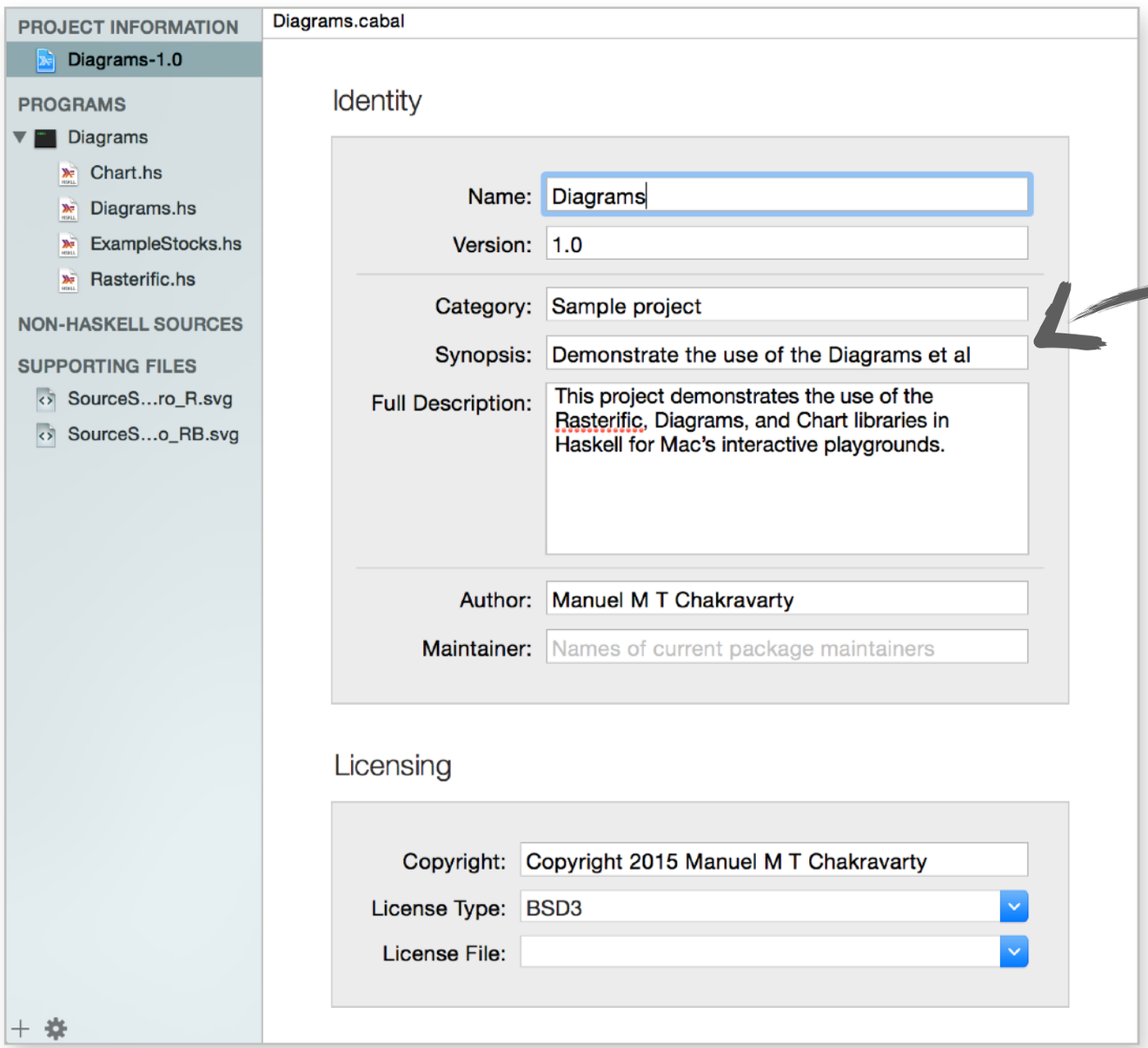
Project Descriptions in Haskell for Mac

View

Serialised Model Data

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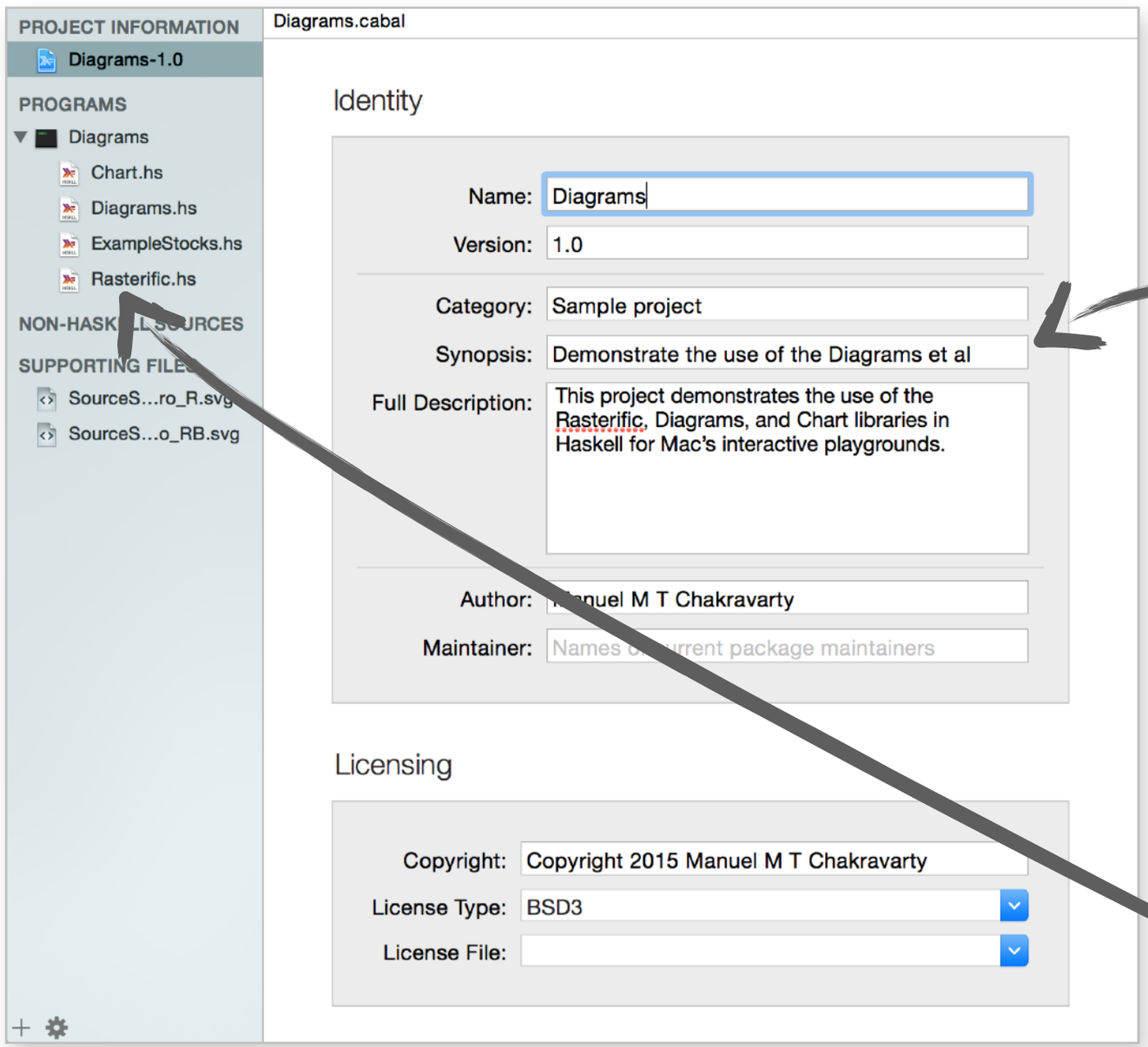
Project Descriptions in Haskell for Mac

View

Serialised **Model** **Data**

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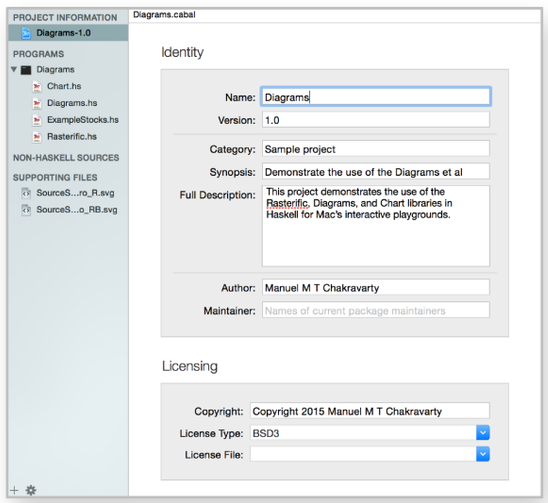
PROJECT INFORMATION
Diagrams-1.0
PROGRAMS
Diagrams
Chart.hs
Diagrams.hs
ExampleStocks.hs
Rasterific.hs
NON-HASKELL SOURCES
SUPPORTING FILES
SourceS…ro_R.svg
SourceS…o_RB.svg
Diagrams.cabal
Identity
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Version: 1.0
Category: Sample project
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Author: Manuel M T Chakravarty
Maintainer: Names of current package maintainers
Licensing
Copyright: Copyright 2015 Manuel M T Chakravarty
License Type: BSD3
License File:


HASKELL
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cabal-version: 1.6
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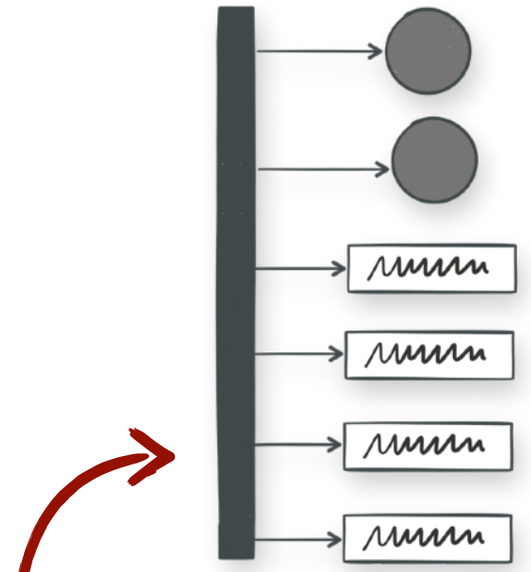
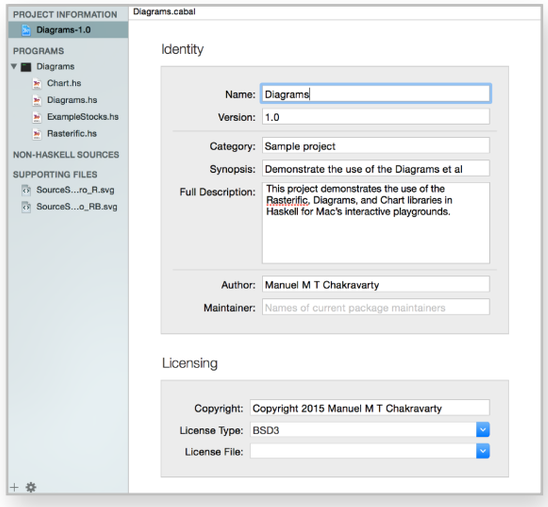
Model

Immutable



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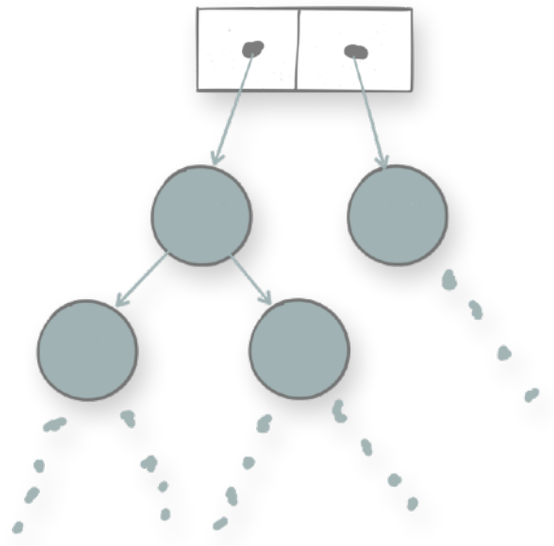
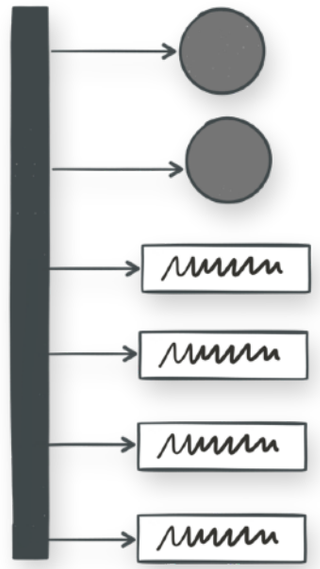
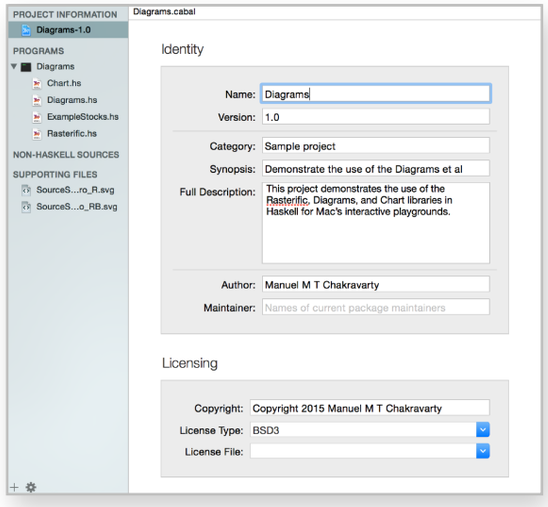
View Model

Model

Immutable





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View | C

View Model

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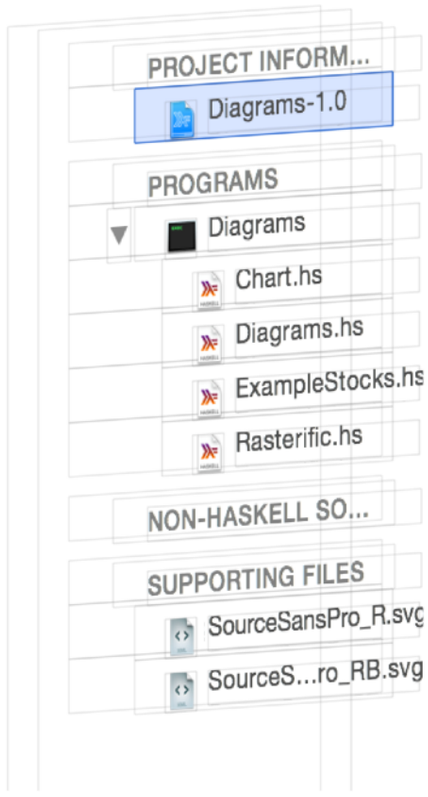

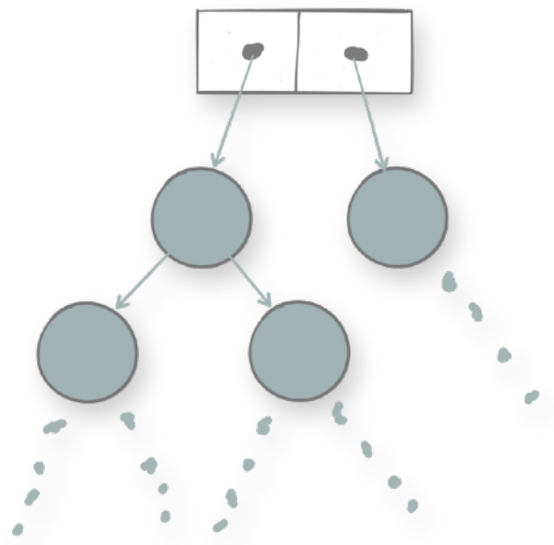

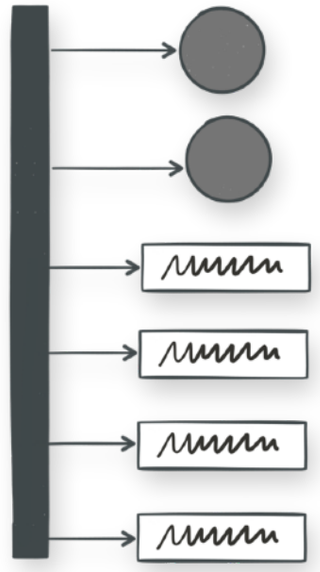

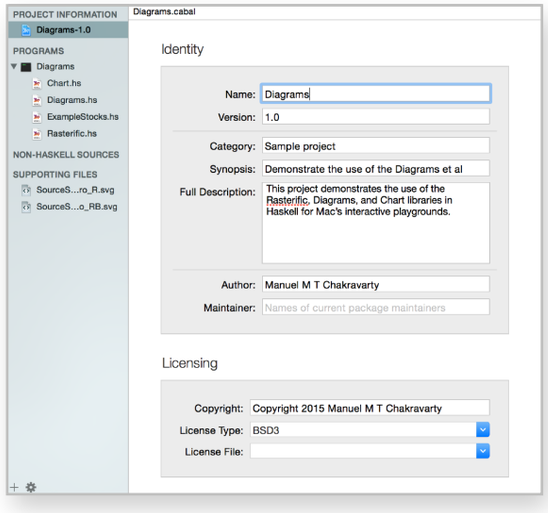


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maintainer:
build-depends:
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homepage:
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al
description: This project demonstrates the use
of the Rasterific, Diagrams, and Chart libraries
in Haskell for Mac's interactive playgrounds.
category: Sample project
author: Manuel M T Chakravarty
tested-with:
data-files: SourceSansPro_R.svg
SourceSansPro_RB.svg
data-dir: ""
extra-source-files:
Executable Diagrams
  main-is: Diagrams.hs
  buildable: True
  other-modules: Chart ExampleStocks Rasterific
```

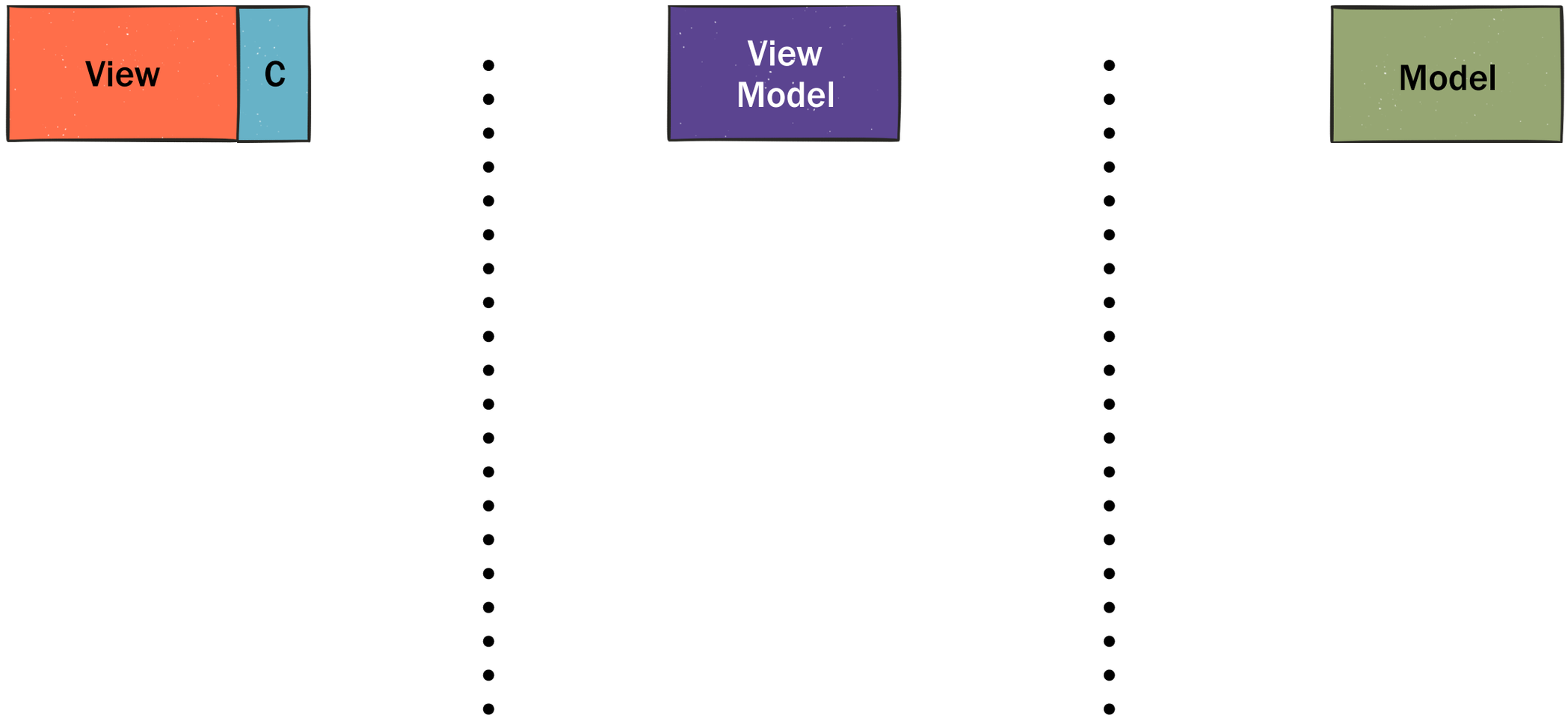
View
C
View
Model
Model

View

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 = PackageDescription {
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    license       :: License,
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    copyright     :: String,
    maintainer    :: String,
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    stability     :: String,
    testedWith    ::
      [(CompilerFlavor,VersionRange)],
    homepage      :: String,
    pkgUrl        :: String,
    bugReports    :: String,
    sourceRepos   :: [SourceRepo],
    synopsis      :: String,
    description   :: String,
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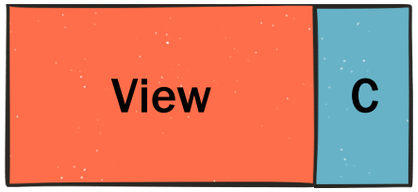

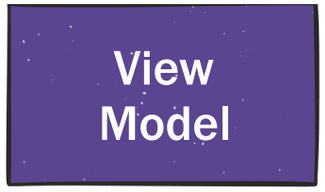

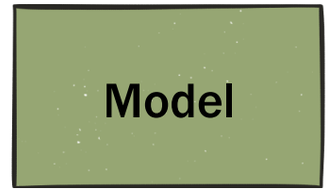


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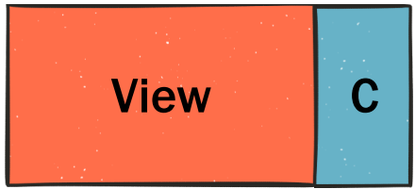

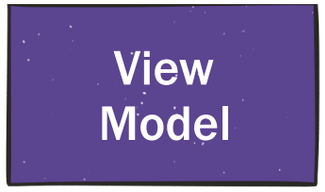

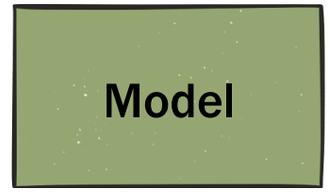


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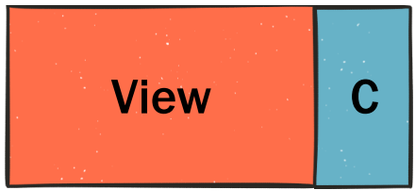

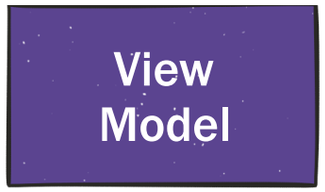

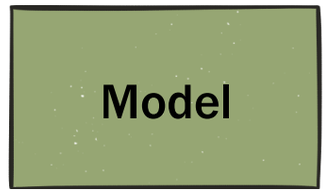


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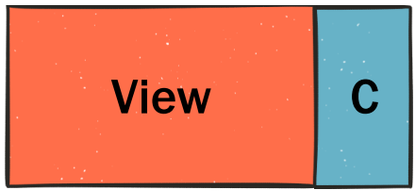

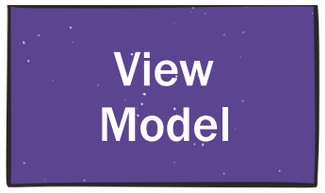

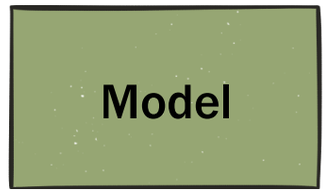


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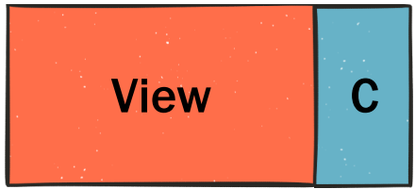

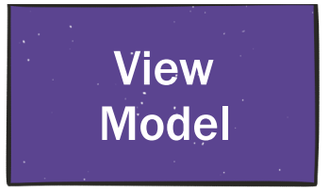

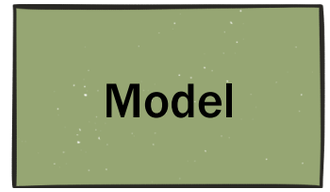


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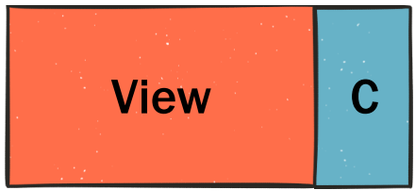

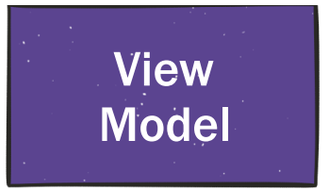

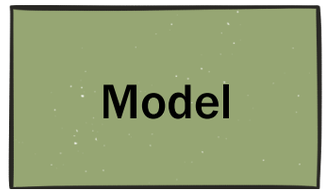


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 weak var nameTextField: NSTextField!
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 let packageItem:          ProjectItem
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View | C

View Model

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Immutable Values

Minimise Mutable State

Immutable by Default

Immutable by Default

Sometimes performance requires mutability

Immutable by Default

Sometimes performance requires mutability

Sometimes an existing API is based on mutability

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Sometimes performance requires mutability

Beware of premature optimisation!

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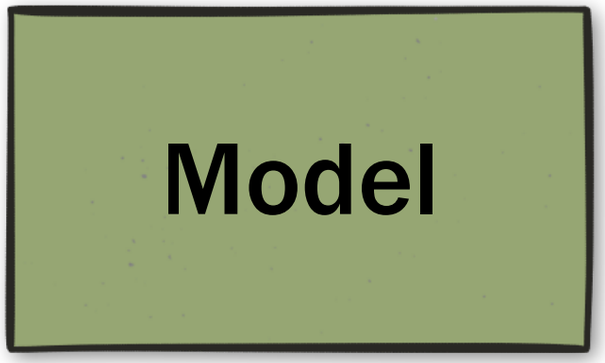
Can you wrap the mutable API?

Immutable



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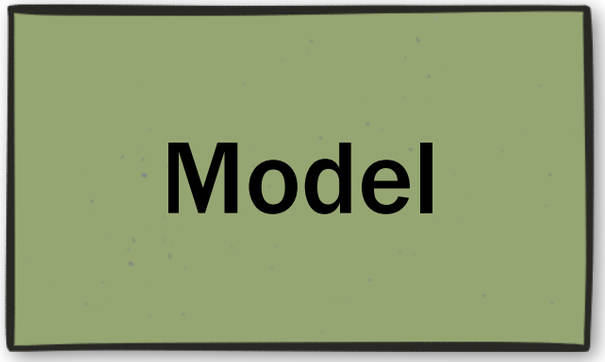
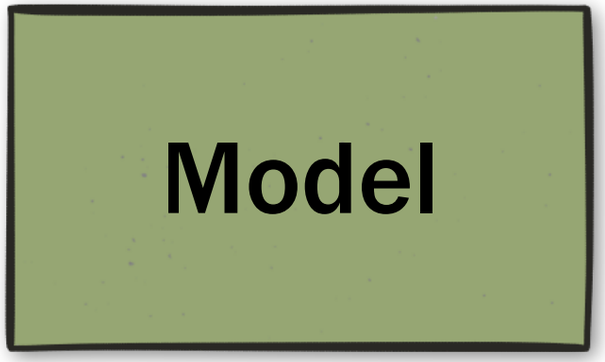


- ✓ Cabal package in Haskell
- ✓ Source files as `NSFileWrapper`

Immutable



✓ Cabal package in Haskell

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Directories are not explicit in the model

Immutable Model

✓ Cabal package in Haskell

✓ Source files as `NSFileWrapper`

Directories are not explicit in the model

At least provide an immutable interface

Hybrid

View Model

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Don’t copy

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Don't copy

Use lets
& structs

Hybrid

View Model

Don’t copy

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Time Series

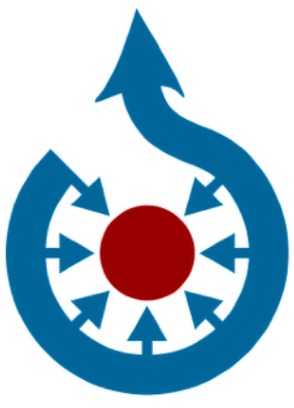
Changes as Streams of Values

Three Principles for FP in a Stateful World

haskellformac.com
mchakravarty
TacticalGrace
justtesting.org

Thank you!

Free Image Sources



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dribbble

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