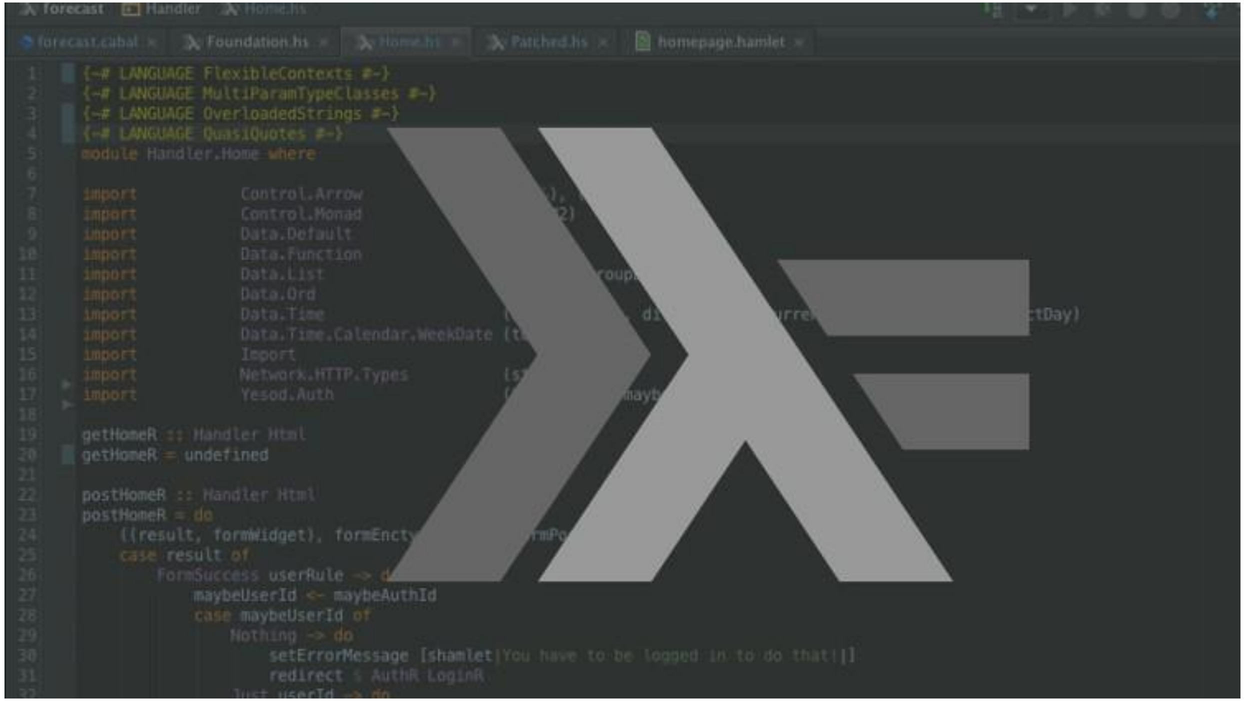
Maybe Instance as Functor



```haskell
{-# LANGUAGE FlexibleContexts #-}
{-# LANGUAGE MultiParamTypeClasses #-}
{-# LANGUAGE OverloadedStrings #-}
{-# LANGUAGE QuasiQuotes #-}
module Handler.Home where

import          Control.Arrow                        (), (
import          Control.Monad                        2)
import          Data.Default
import          Data.Function
import          Data.List                            roup
import          Data.Ord
import          Data.Time                   (      , di      urre              tDay)
import          Data.Time.Calendar.WeekDate (t
import          Import
import          Network.HTTP.Types          (s
import          Yesod.Auth                  (             mayb

getHomeR :: Handler Html
getHomeR = undefined

postHomeR :: Handler Html
postHomeR = do
    ((result, formWidget), formEncty          rmPo
    case result of
        FormSuccess userRule -> d
            maybeUserId <- maybeAuthId
            case maybeUserId of
                Nothing -> do
                    setErrorMessage [shamlet|You have to be logged in to do that!|]
                    redirect $ AuthR LoginR
                Just userId -> do
```

Functors

We already know how to apply functions:

```
λ> (+3) 2                  👉   5
```

But...

```
λ> (+3) (Just 2)             ❌
```

In this case, we can use `fmap`!

```
λ> fmap (+3) (Just 2)      👉   Just 5
λ> fmap (+3) Nothing       👉   Nothing
```

And it also works with `Either`, lists, tuples and functions:

```
λ> fmap (+3) (Right 2)      👉   Right 5
λ> fmap (+3) (Left "error")  👉   Left "error"

λ> fmap (+3) [1, 2, 3]      👉   [4, 5, 6]          -- same as map

λ> fmap (+3) (1, 6)         👉   (1, 9)             -- because (,) is a type

λ> (fmap (*2) (+1)) 3       👉   8                  -- same as (.)
```

Implementation of fmap

`fmap` applies a function to the elements of a generic container `f a` returning a container of the same type.

`fmap` is a function of the instances of the class `Functor`:

```
λ> :type fmap
fmap :: Functor f => (a -> b) -> (f a -> f b)
```

Where

```
λ> :info Functor
class Functor f where
    fmap :: (a -> b) -> (f a -> f b)
```

Maybe is Functor

The type `Maybe` is instance of `Functor`:

```
λ> :info Maybe
data Maybe a = Nothing | Just a
instance Ord a => Ord (Maybe a)
instance Eq a => Eq (Maybe a)
instance Applicative Maybe
instance Functor Maybe
instance Monad Maybe
⋮
```

Concretely,

```
instance Functor Maybe where
    fmap f Nothing = Nothing
    fmap f (Just x) = Just (f x)
```

Application

Database Query

- Language without `Maybe`:

```
post = Posts.find(1234)
if post is None:
    return None
else:
    return post.title
```

- In Haskell:

```
fmap getPostTitle (findPost 1234)
```

or also:

```
getPostTitle `fmap` findPost 1234
```

or better (`<$>` is the infix operator `fmap`): (it is read *fmap*)

```
getPostTitle <$> findPost 1234
```

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