COMP90048: Workshop 9

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Monads for great good

Setting the stage

- Consider the function `head :: [a] -> a`. What if you give it an empty list?

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```
Prelude> head []

*** Exception: Prelude.head: empty list
```

Setting the stage

- **Better:**

```
maybeHead :: [a] -> Maybe a

maybeHead [] = Nothing

maybeHead (x:_) = Just x
```

Setting the stage

- **Example:** you are parsing a string and if it's a non-negatie number, find its square root.

```
maybeRead :: Read a => String -> Maybe a

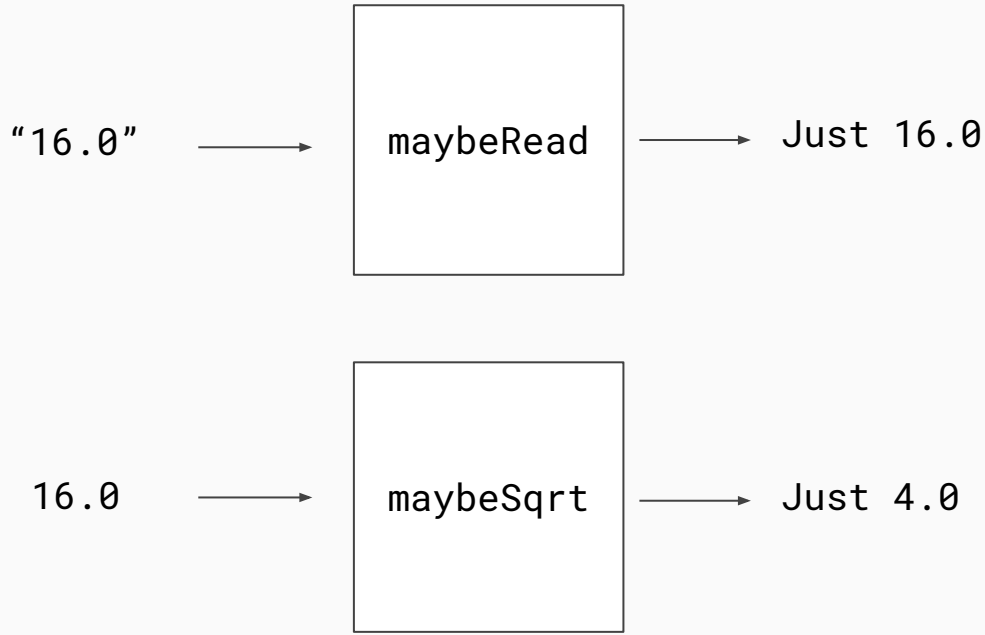
maybeSqrt :: Floating a => a -> Maybe a

maybeSqrt x

    | x >= 0    = Just (sqrt x)

    | otherwise = Nothing
```

Setting the stage



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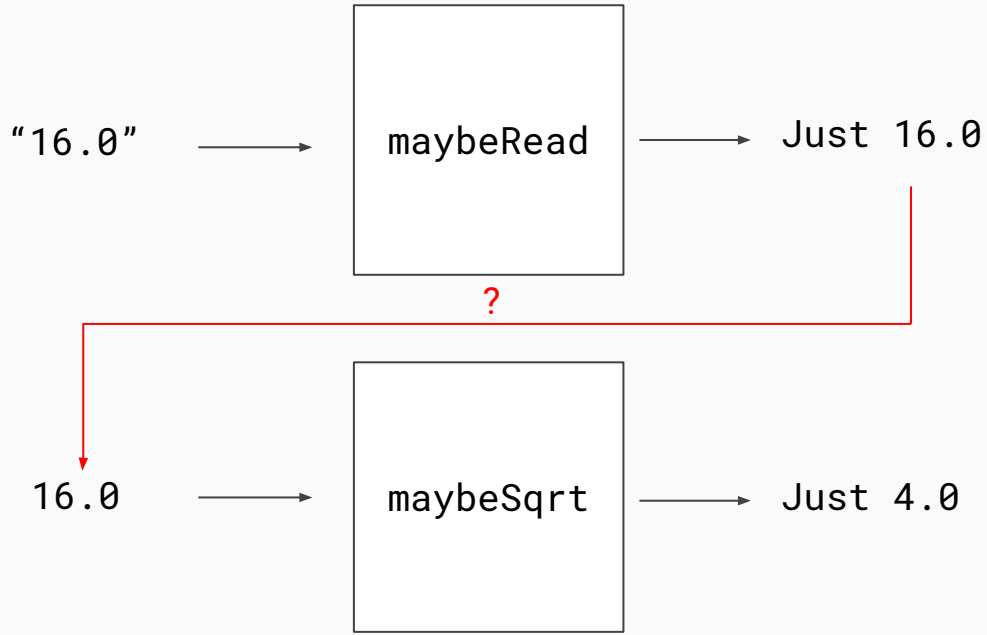

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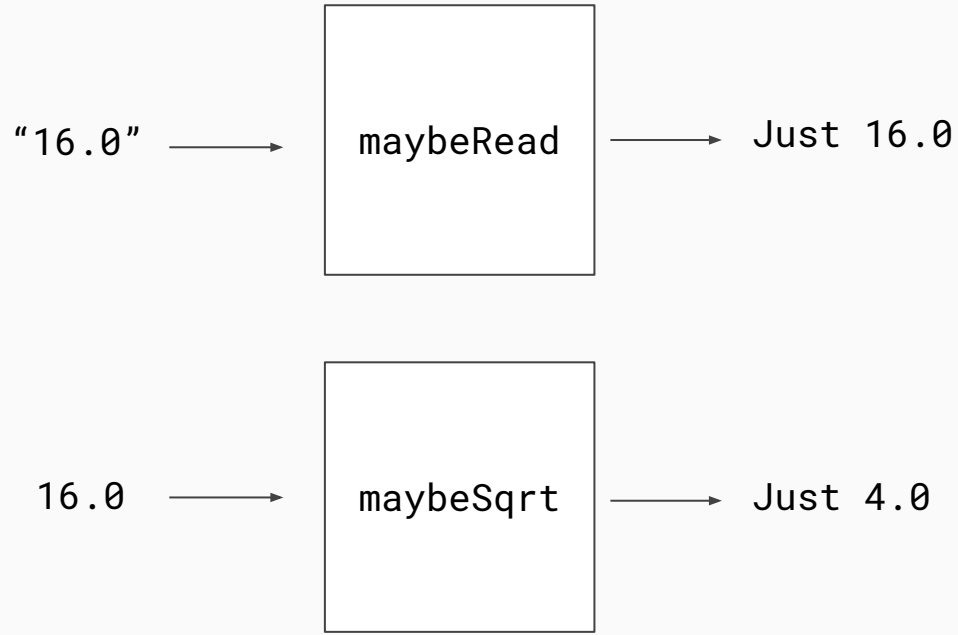
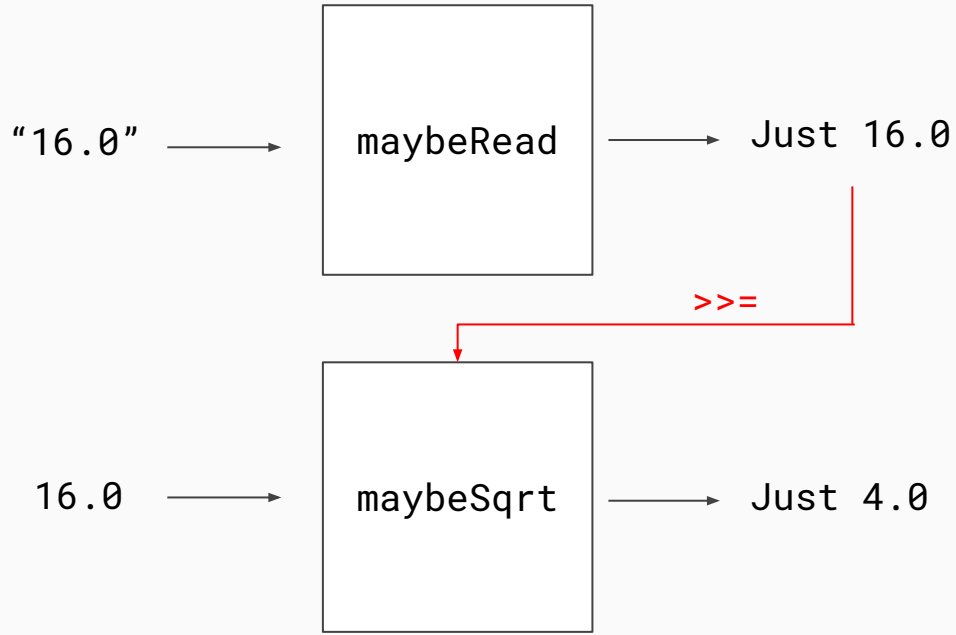



```
readAndSqrt :: String -> Maybe Double
readAndSqrt str = case maybeRead str of
    Nothing -> Nothing
    Just x  -> maybeSqrt x
```

Introducing monadic bind!




```
readAndSqrt :: String -> Maybe Double
readAndSqrt str =
     maybeRead str >>= maybeSqrt
```

Introducing monadic bind!

- The **bind** operation combines functions that operate on **monads**.

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(>>=) :: Monad m => m a -> (a -> m b) -> m b
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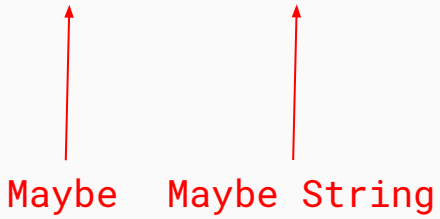

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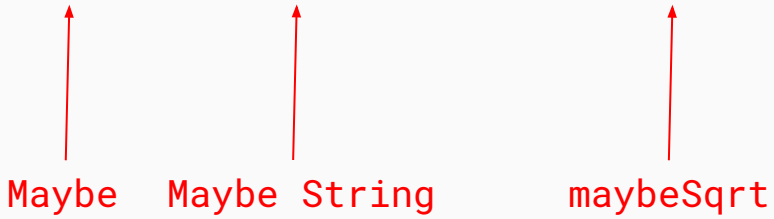

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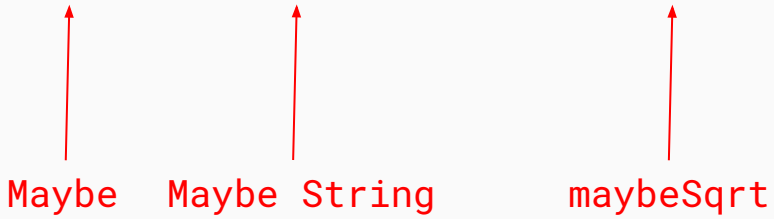

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  - `Maybe a` is the type `a` with the context “may be missing”
  - `[a]` is the type `a` with the context “additional data may follow”

What is a monad?

- Monads define two basic operations:
  - `(>>=)  :: m a -> (a -> m b) -> m b`
    (monadic bind)
  - `return :: a -> m a`
    (“lift” a value into the monad)

Monads encapsulate side effects

- Haskell normally prevents side effects. Monads allow side effects *in strict contexts*.

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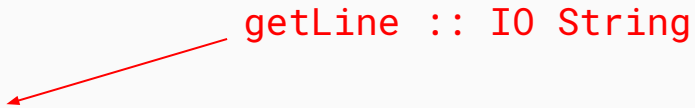

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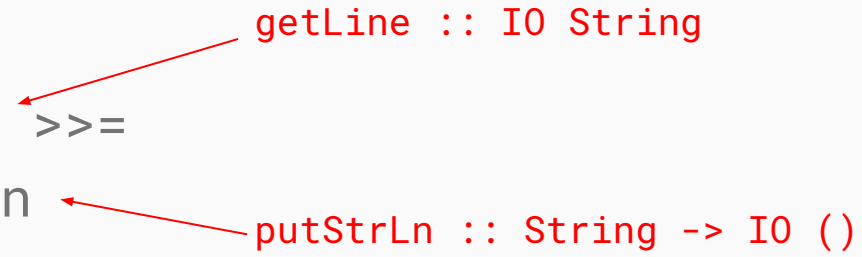

More side effects

```
greeter :: IO ()
greeter = putStr “First name:“ >>
          getLine >>= \first ->
          putStr “Last name:“ >>
          getLine >>= \last ->
          putStrLn (“Hello, “ ++ first
                    ++ “ “ ++ last ++ “!”)
```

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```

ignore return value

we’ll use the return value later

do notation

```
greeter :: IO ()
greeter = do
    putStr “First name: “
    first <- getLine
    putStr “Last name: ”
    last  <- getLine
    putStrLn $ “Hello, “ ++ first ++ “ “ ++ last ++ “!”
```

Practice, practice, practice!