Intro to Haskell

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Speaker

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Slides

available at http://lispcast.com/haskell-slides

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– Alan Perlis

why?

- get started in Haskell
- speak intelligently about Haskell
- get a feel for Haskell
- learn from my mistakes

especially if you typically use dynamic languages

me

- <u>not</u> an expert
- working > 1 year in Haskell
- learned on the job
- prefer dynamic languages
- appreciate static checking

Haskell

- static & strong type system
- purely functional
- lazy evaluation

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- purely functional
- lazy evaluation

- significant whitespace
- compiled
- garbage collected
- pattern matching
- from academia (but still practical)

type system

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  - types known at compile time
  - some explicit
  - some inferred
  - thrown away at compile time

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if the compiler cannot determine the exact type, compilation fails

purely functional & lazy

- functions are values (with types)

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separate out calculations from side effects

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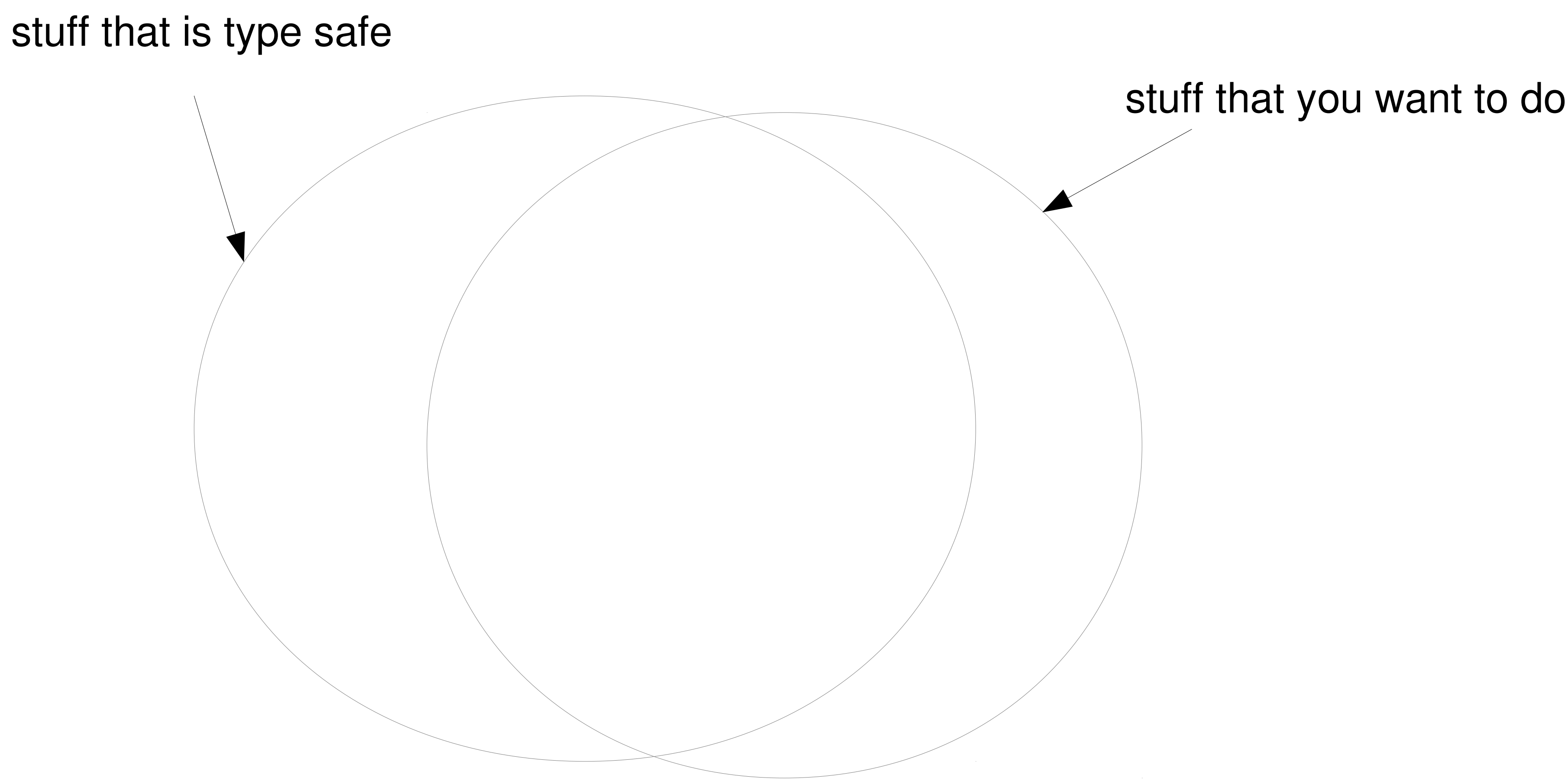
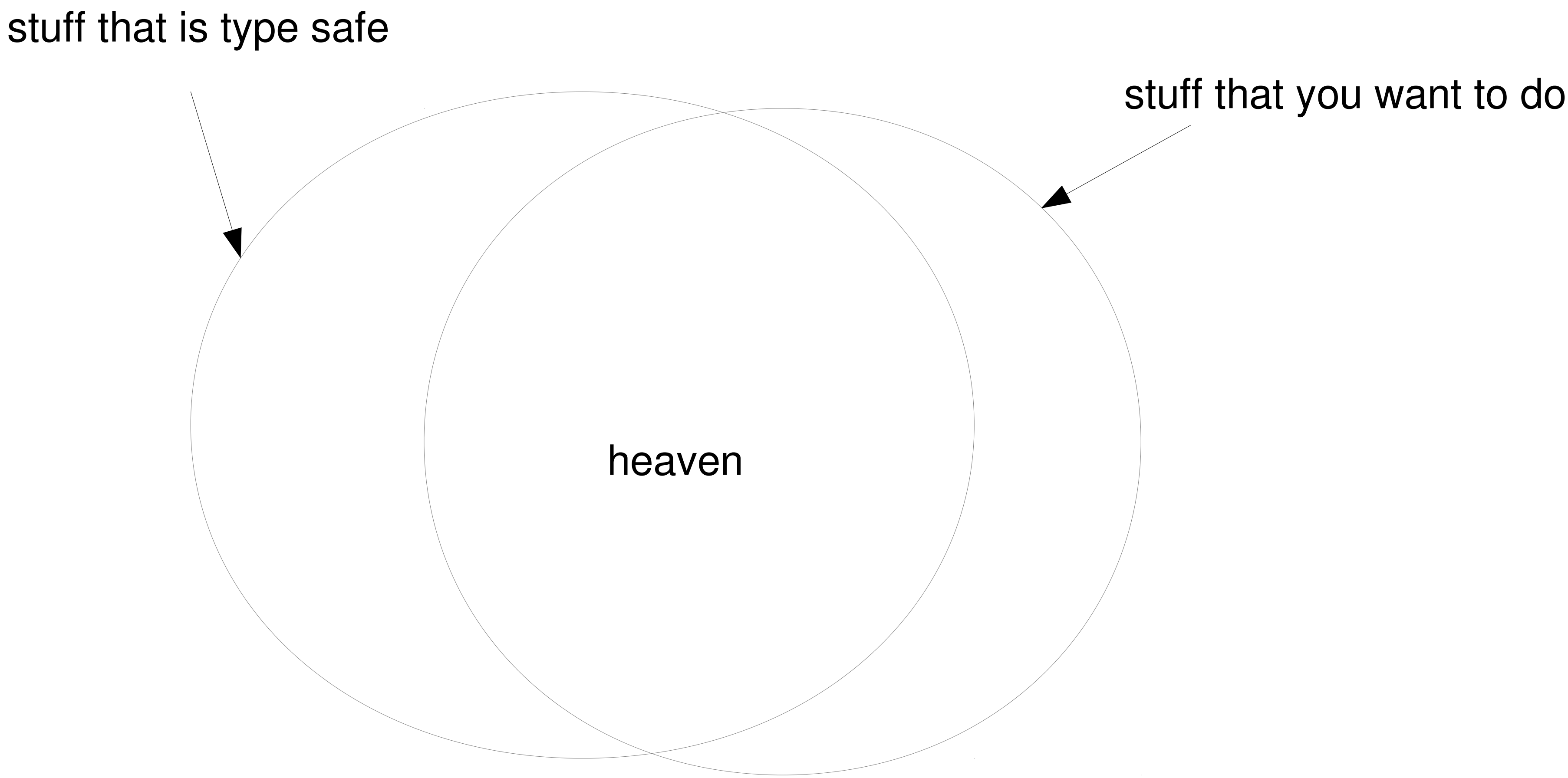
– me


stuff that is type safe
stuff that you want to do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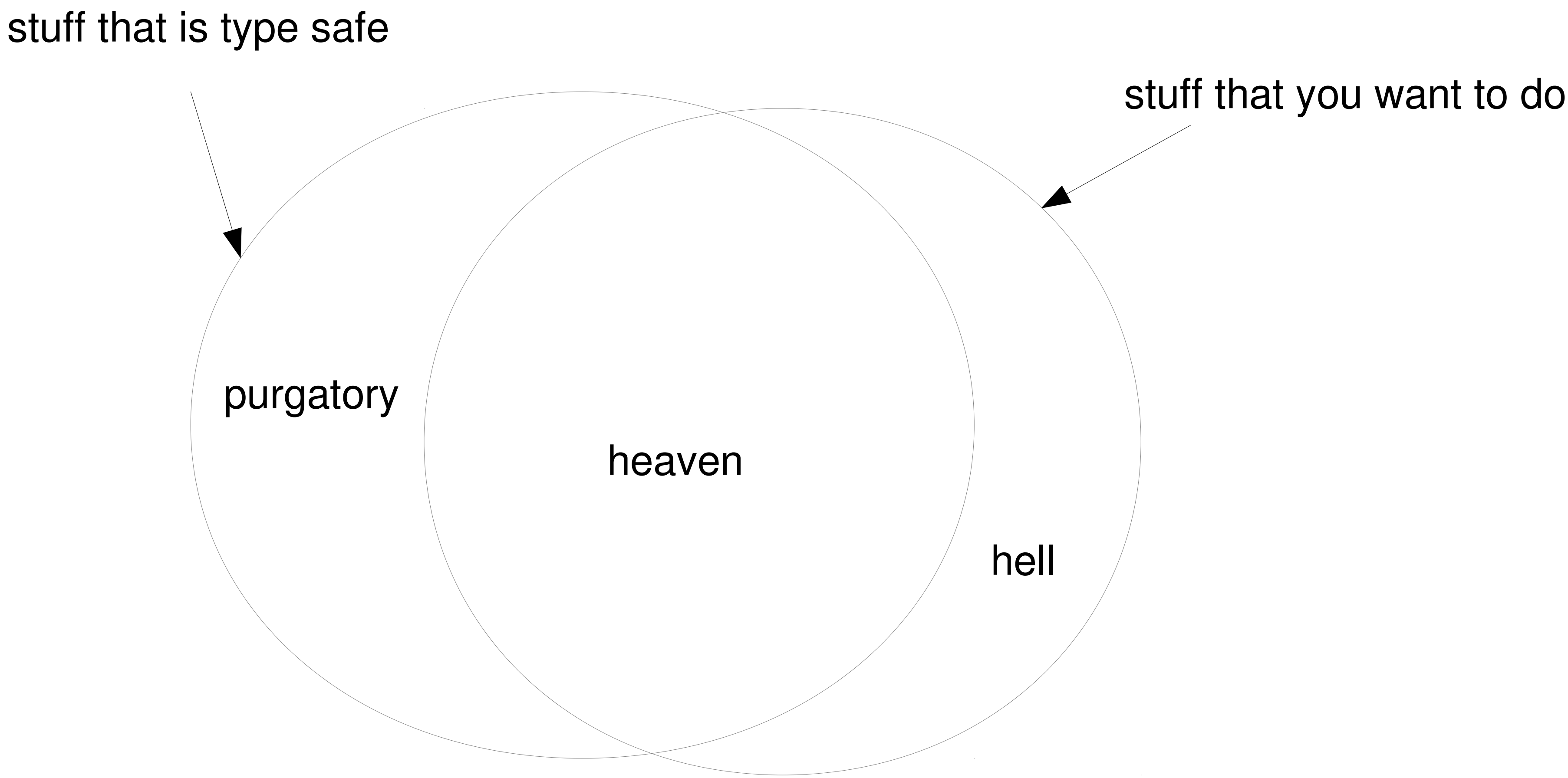
heaven


stuff that is type safe
stuff that you want to do
purgatory
heaven
hell

http://www.flickr.com/photos/60414609@N00/5298363220/

constants

```
a = 10
pi = 3.14159
name = “Eric”
pisquared = pi * pi
```

great for fib

```
fib 0 = 1

fib 1 = 1

fib n = fib (n-1) + fib (n-2)
```

lists

```
map _ []      = []
map f (x:xs) = f x : map f xs

concat [] l2 = l2
concat (l:ls) l2 = l : concat ls l2
```

types

```
a :: Int
a = 10
```

types

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a :: Int
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name :: String
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types

```haskell
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fib :: Int -> Int
fib 0 = 1
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name :: String
name = “Eric”

fib :: Int -> Int
fib 0 = 1
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fib n = fib (n-1) + fib (n-2)

map :: (a -> b) -> [a] -> [b]
map _ []     = []
map f (x:xs) = f x : map f xs
```

functions all the way down

```
double x = 2 * x
```

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(*) :: Int → Int → Int

(*) :: Int → (Int → Int)
```

functions all the way down

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double x = 2 * x
double = 2 *


(*) :: Int → Int → Int
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double :: Int → Int
(2 *)  :: Int → Int
```

scoping

- function application
  - left to right

```
f g h 1 ==> (((f g) h) 1)
```

```
map map square [[1,2],[3,4]]
    ==> (((map map) square) [[1,2],[3,4]])
```

```
map (map square) [[1,2],[3,4]]
```

take a break

we are about to embark
on a journey deep into the type system

http://www.flickr.com/photos/samrich2003/5654034532/

you cannot ignore types

- in Java, you look at types and think “this method takes a string, an int, and returns a list”
  - that's all you need to think about
- in Haskell, this is enough to get you started but you will hit a ceiling

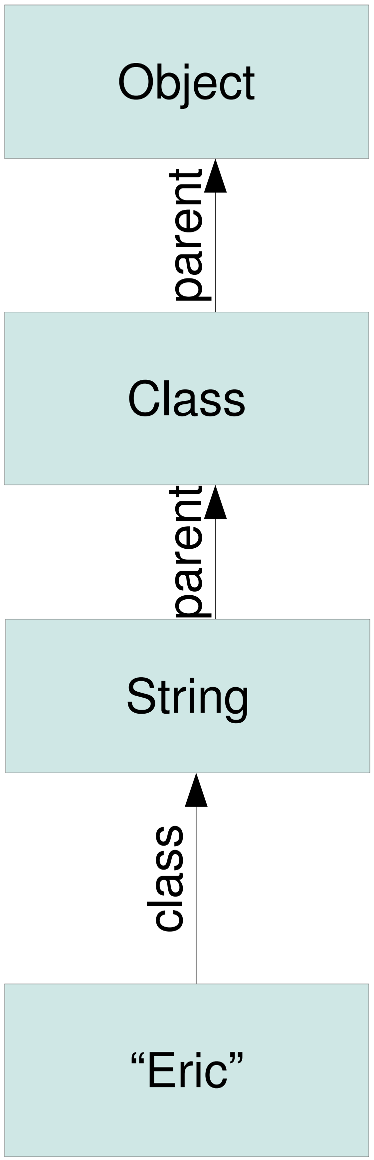
master the types or they will master you

typical dynamic class diagram

objects have a class

classes have a parent

classes are objects



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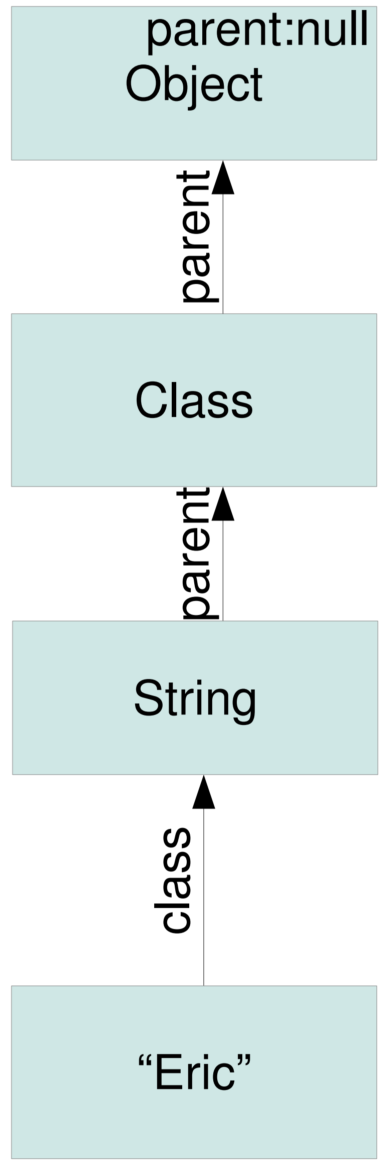

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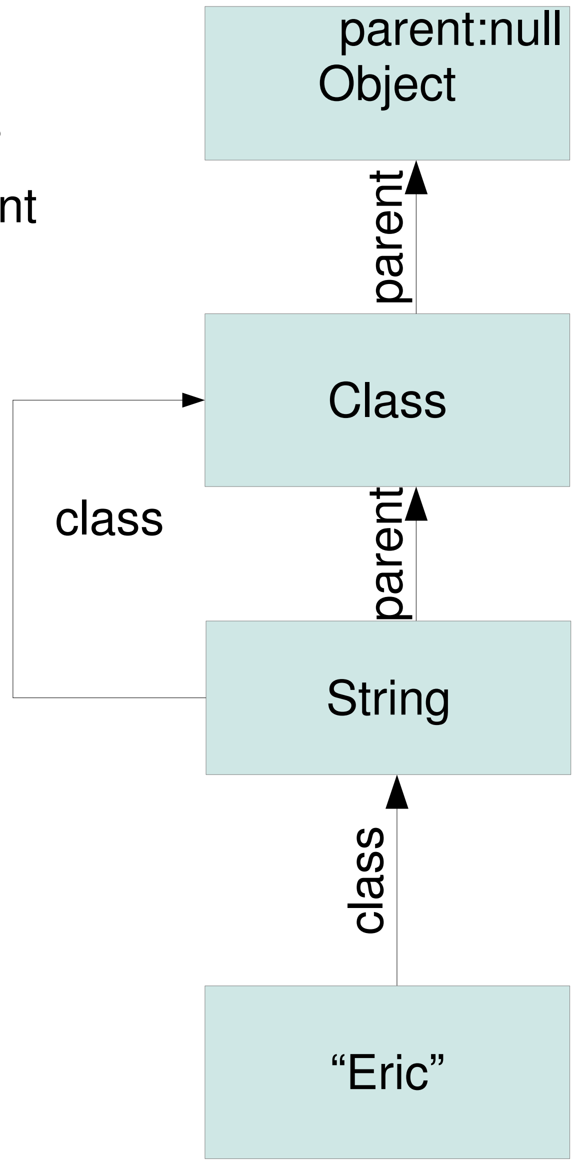

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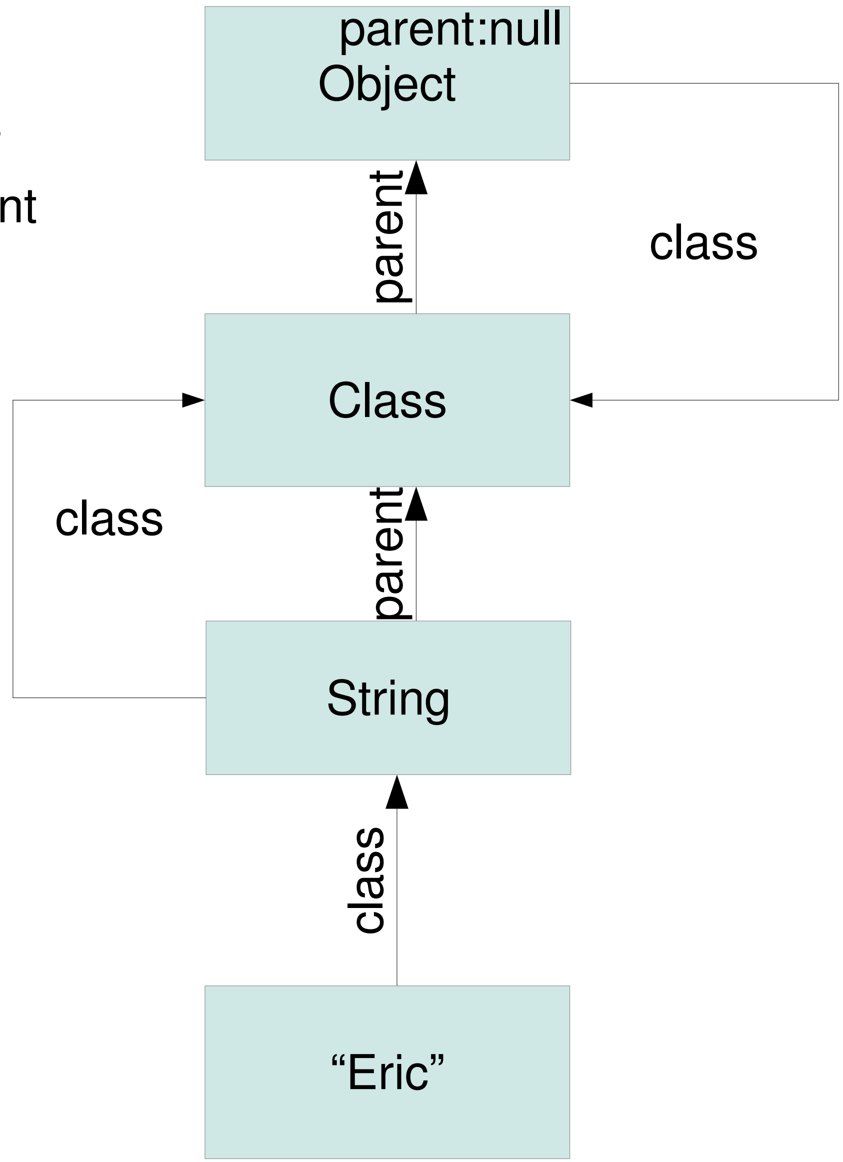

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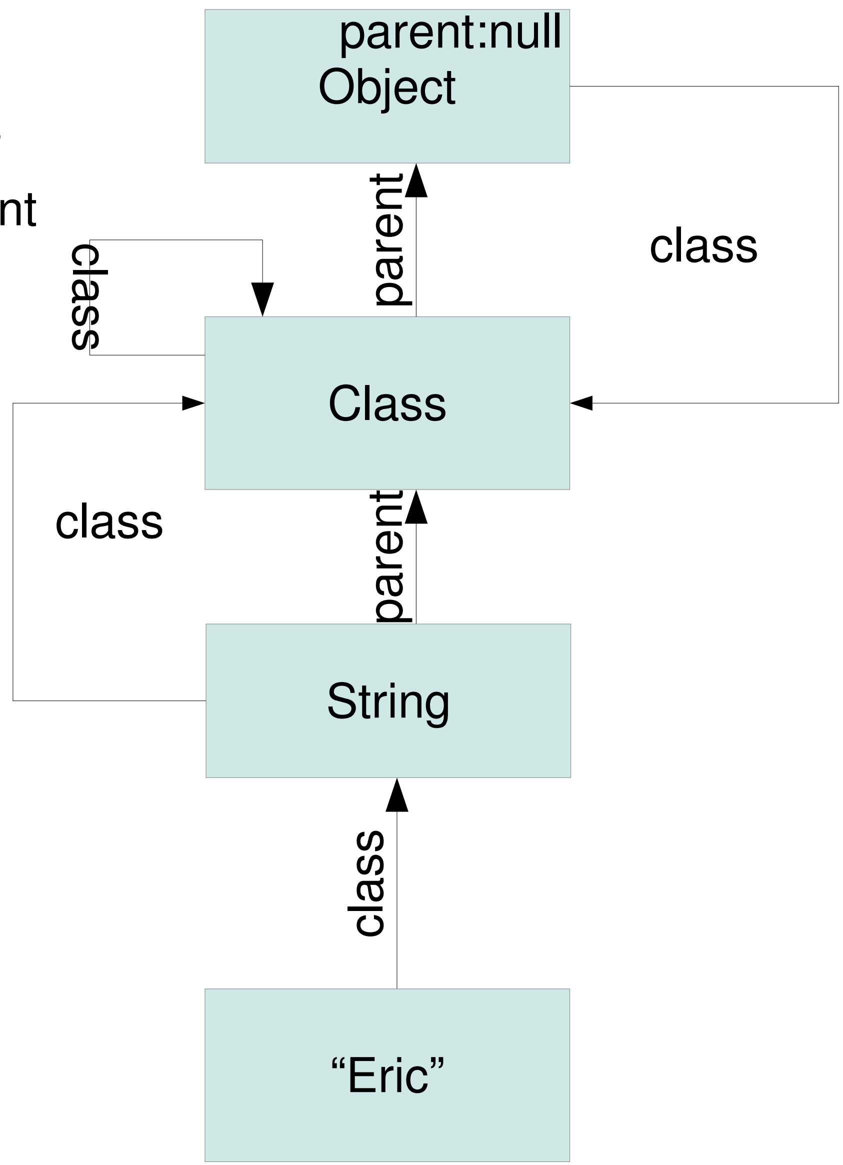
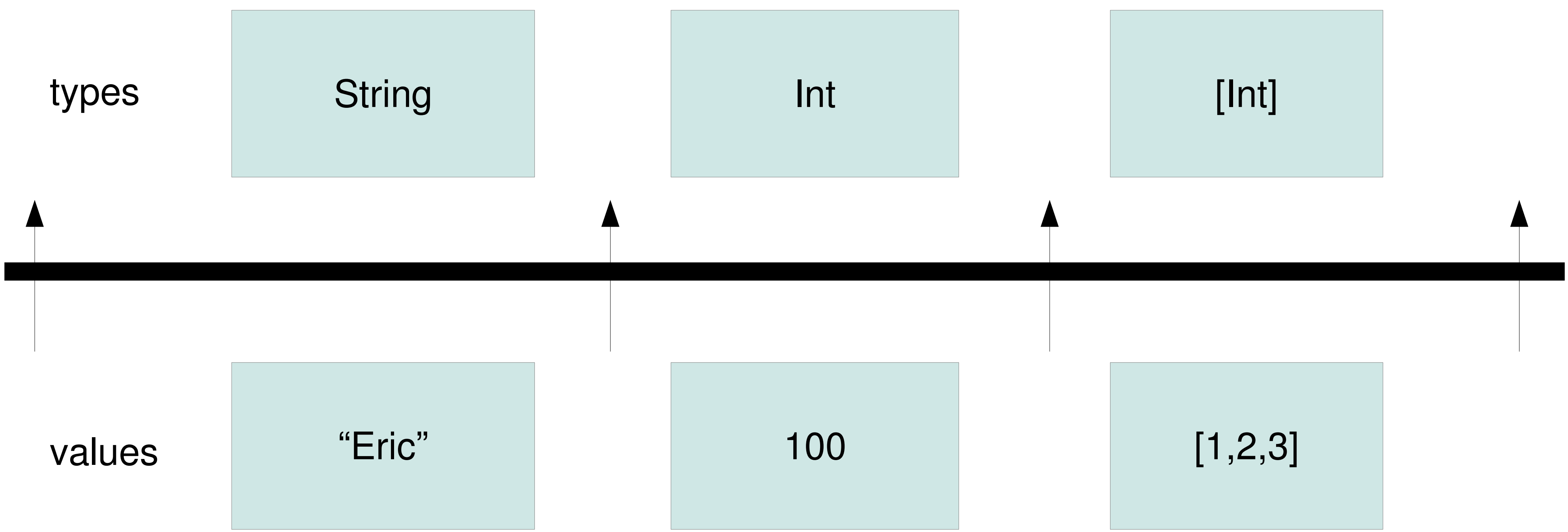


Haskell types

values	“Eric”	100	[1,2,3]

Haskell types



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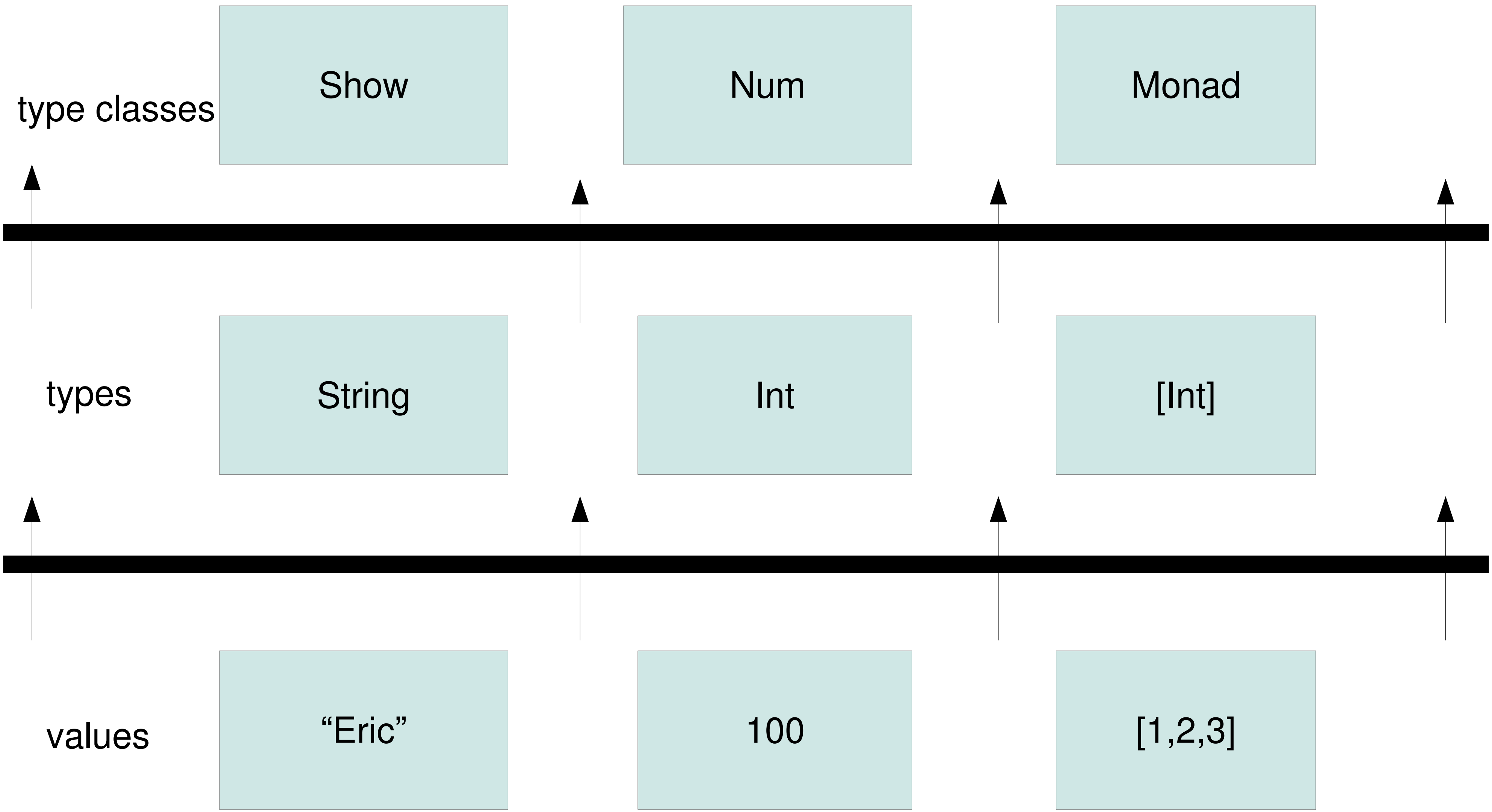

Maybe

- ever thrown a null pointer exception?
- Maybe is the answer

```
data Maybe a = Nothing | Just a
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find p (x:_) | p x = Just x
find p (_:xs) = find p xs
```

a little safety

```
case find even [1,3,5,7] of
    Just n    → …
    Nothing → ...
```

- compiler will complain if you patter match and forget to check for all cases
- but there are still holes
  - fromJust :: Maybe a → a
  - errors if it's Nothing

type classes

- used for compile-time polymorphism
- huh?
  - they define an interface
  - set of functions
  - implementations for a given type

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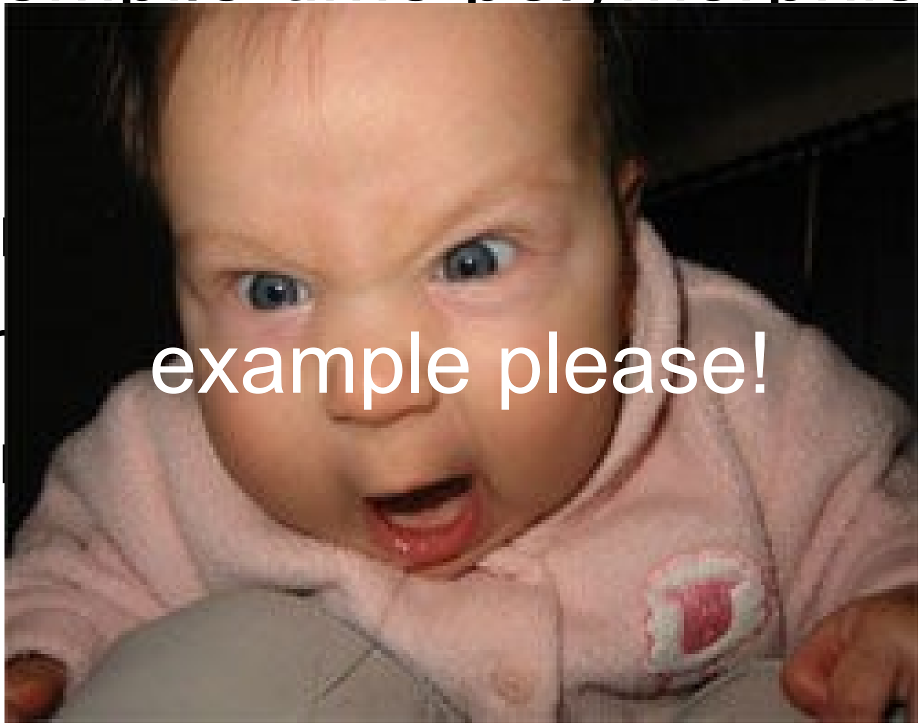

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type class Show

```
class Show a where
  show :: a → String

instance Show String where
  show s = s

instance Show Int where
  show = intToString
```

type class Num

```
class Num a where
   (+) :: a → a → a
   (*) :: a → a → a
   (-) :: a → a → a
   (/) :: a → a → a

instance Num Int where
   (+) = intPlus
   (*) = intTimes
   (-) = intMinus
   (/) = intDivide
```

Monad

- don't panic
- not that hard
- a way to compose actions
- type class
  - with type parameter
- IO is a special Monadic type handed down from the gods (the Haskell compiler/runtime)

Monad

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Monad type class

```
class Monad m where
  -- bind (or then)
  (>>=) :: m a -> (a -> m b) -> m b
  -- create a new value in the Monad
  return :: a -> m a
```

Maybe is a Monad

- Maybe is common. You don't want to indent every time you need to check for Nothing.
- Monads can help.

```
instance Monad Maybe where
  Nothing  >>= _ = Nothing
  (Just a) >>= f = f a
  return = Just
```

using our Monad

```
readint :: String → Maybe Int
index :: [a] → Int → Maybe a


readint s >>= index [1,2,3]
```

dev environment

- Haskell Platform
- emacs (or any text editor)
  - haskell-mode
    - insert type signatures
    - interactive shell
- vim has syntax highlighting
  - haskellmode
- apt-get install cabal-install

books and tutorials

- Real World Haskell
  - free online
- Learn you a Haskell for Great Good
  - free online
- I cannot recommend a Monad tutorial
- The Monad Reader (newsletter)

resources

- hoogle : search engine for Haskell libraries
  - understands types and special characters
- hackage : Haskell library repository
  - versioned libraries with dependencies
  - wild west

final tips

- Haskell is used for two things
  - programming
  - theorem proving
- More blog posts are written for the second one
- Compile often; make the compiler your friend
- Learn the standard libraries
- Model your problem in types