Type Class: The Ultimate Ad Hoc

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August 2, 2017

Type classes are a language feature

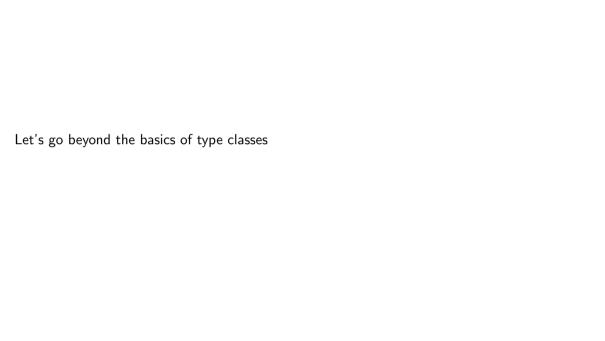
- Haskell
- Eta
- Purescript
- Clean

Type classes are a language feature

- Haskell
- ► Eta

► Clean

- Purescript
- or sometimes a design pattern
- Scala
 - ▶ OCaml



Polymorphism

Polymorphism is good

- greater reuse
- less repetition
- fewer names need inventing
- fewer possible implementations

Broadly speaking there are two major forms of polymorphism:

- parametric polymorphism
- ► ad-hoc polymorphism

Parametric polymorphism (sometimes called *generics*)

A value is parametrically polymorphic iff it has at least one *type parameter* which can be instantiated to *any type*.

Parametrically polymorphic functions behave the same way no matter which type they are instantiated to.

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```
reverse :: [a] -> [a]
id :: a -> a
(.) :: (b -> c) -> (a -> b) -> a -> c
```

Ad-hoc polymorphism

A value which is ad-hocly polymorphic can be instantiated to different types, and may behave differently at each type

```
(==) :: Eq a => a -> a -> Bool
```

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```

```
eqBool :: Bool -> Bool -> Bool
eqBool True True = True
eqBool False False = True
eqBool False True = False
```

eqBool True False = False

```
(==) :: Eq a => a -> a -> Bool
egBool :: Bool -> Bool -> Bool
egBool True True = True
eqBool False False = True
eqBool False True = False
eqBool True False = False
egString :: String -> String -> Bool
egString [] = True
eqString (_: _) [] = False
eqString [] (_: _) = False
```

eqString (c:cs) (d:ds) = eqChar c d && eqString cs ds



```
public interface Equal<A> {
   public boolean eq(A other);
}
```

```
public interface Equal<A> {
  public boolean eq(A other);
public class Person implements Equal<Person> {
  public int age;
  public String name;
  public boolean eq(Person other) {
    return this.age == other.age && this.name.equals(other.name);
```

```
import java.util.List;

public class EqualMethods {
   public static <A extends Equal <A>> boolean elementOf(A a, List <A>
        for (A element : list) {
        if (a.eq(element)) return true;
     }
     return false;
}
```

elementOf exhibits ad-hoc polymorphism

Type Classes

class Equal a where

eq :: a -> a -> Bool

```
class Equal a where
  eq :: a -> a -> Bool

data Person = Person {
  age :: Int
```

, name :: String

```
class Equal a where
  eq :: a -> a -> Bool

data Person = Person {
  age :: Int
, name :: String
```

```
instance Equal Person where
```

eq p1 p2 = eq (age p1) (age p2) && eq (name p1) (name p2)

```
elementOf :: Equal a => a -> [a] -> Bool
elementOf a list = any (eq a) list
```