



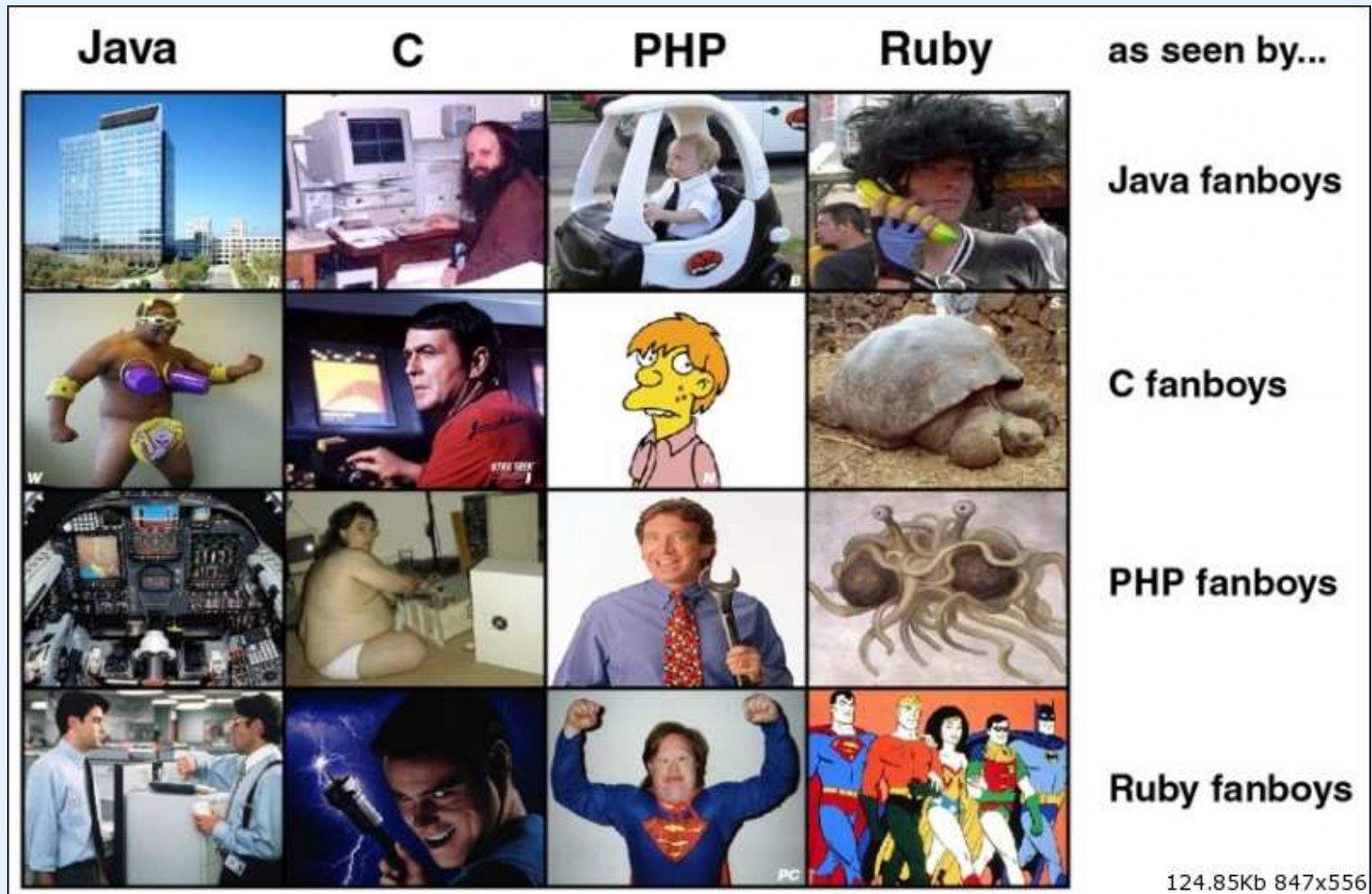
# Eigenclasses, Singletons, What?

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Monday, June 8, AD 2015

# Ruby is Weird and Awesome!



# Everything is a Thing

```
1 12.class # Fixnum
2 "Hi_there".class # String
3 2.71828.class # Float
4 [1, 2, 3].class # Array
5 {age: 36, name: "Chris"}.class # Hash
6 :foo.class # Symbol
```

## We Can Insist on the “Right” Thing

We’ll explain the difference between the concepts “instance of,” “is a,” and “kind of” in a few slides.

```
1 if not k.class == Fixnum
2   raise ILoveOnlyNumbers
3 end
4 if not m.instance_of? Fixnum
5   raise ILoveOnlyNumbers
6 end
7 if not n.is_a? Fixnum
8   raise ILoveOnlyNumbers
9 end
10 if not o.kind_of? Fixnum
11   raise ILoveOnlyNumbers
12 end
```

## We Can Do Different Things to Different Things

```
1 if n.class == Fixnum
2   puts "Whole_Numbers_FTW!!!"
3 elsif n.class == Float
4   puts "More_Accuracy_is_MORE!!!"
5 else
6   raise ILoveOnlyNumbers
7 end
```

## Even Classes are Things!

This is one of the more unique aspects of Ruby. In a lot of other object-oriented programming languages, classes are “special” somehow, and you can’t treat them the same way as everything else.

```
1 :foo.class # Symbol
2 :foo.class.class # Class
3 :foo.class.class.class # Class
```

We’ll see how that’s actually really nice and useful in a bit.

# We Can Make Our Own Classes

```
1 class Cat
2   def initialize color
3     @color = color
4     @lives = 9
5   end
6   def die
7     @lives = @lives - 1
8   end
9   def alive?
10    @lives >= 1
11  end
12  def eat_tuna
13    puts "Purrr!"
14  end
15 end
16 lucky = Cat.new "black"
17 lucky.alive? # true
```

## Classes Have Methods

And those methods let our class instances do things.

```
1 class ATM
2   def initialize amount
3     @amount = amount
4   end
5   def deposit account, amount
6     @amount = @amount + amount
7     account.deposit amount
8   end
9   def withdraw accout, amount
10    raise GoAwayPeasant if amount > account.amount
11    raise RunOnTheBank if amount > @amount
12    account.withdraw amount
13    @amount = @amount - amount
14  end
15 end
```



## Instances Can Have Their Own Stuff



## Instance Variables

Instance variables are written with an at-sign like `@foo`, and are per-instance.

```
1 class Person
2   attr_reader :age, name
3   def initialize(age, name)
4     @age = age
5     @name = name
6   end
7 end
8 john = Person.new 12, "John_Jacobson"
9 fred = Person.new 44, "Fred_Fellows"
10 john.age # 12
11 fred.age # 44
12 john == fred # false
```

## Getters and Setters



## Getters and Setters

```
1 class Car
2   attr_accessor :color
3   attr_reader :mileage
4   def initialize(color, mileage)
5     @color, @mileage = color, mileage
6   end
7   def drive miles
8     @mileage = @mileage + miles
9   end
10 end
11 c = Car.new 4, :blue
12 c.drive 92_000
13 c.mileage # 92004
14 c.color = :green
15 c.mileage = 123 # NoMethodError: undefined method `mileage='
```

## Class Variables

Class variables are written with two at-signs like @@foo, and are per-class. They are almost never what you actually want.

```
1 class People
2   @@population = 0
3   attr_reader :name, :age
4   def initialize(name, age)
5     @@population = @@population + 1
6     @alive = true
7     @name, @age = name, age
8   end
9   def die
10    @alive = false
11    @@population = @@population - 1
12  end
13 end
```

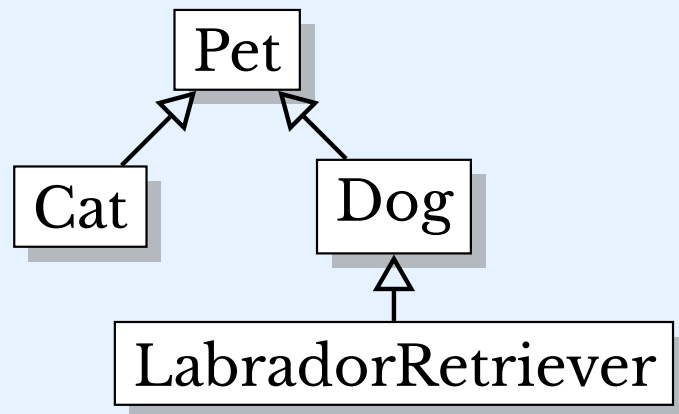
## Class Methods

```
1 class Person
2   attr_reader :name, :born, :died
3   def initialize(name, born, died)
4     @name, @born, @died = name, born, died
5   end
6   class << self
7     def from_s s # String like "John Doe (1912 - 1990)"
8       name, born, died = s.scan(/(.*)\((\d+) - (\d+)\)/)[0]
9       Person.new name, born.to_i, died.to_i
10    end
11  end
12 end
13 george = Person.from_s "George_Washington_(1732_-1739)"
14 ben = Person.from_s "Benjamin_Franklin_(1706_-1790)"
```

# Inheritance



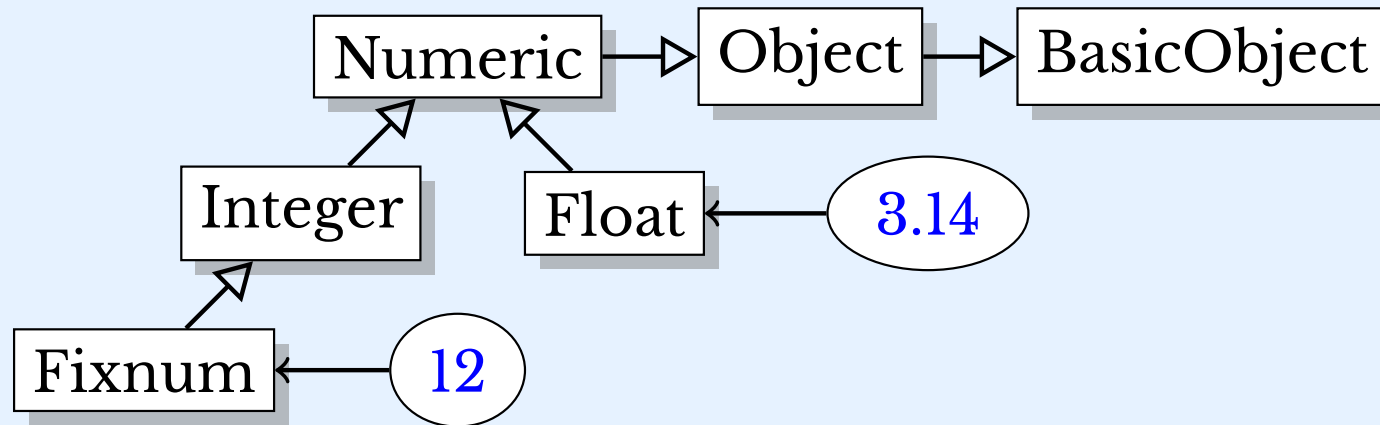
# Inheritance



```
1 class Pet
2 end
3 class Cat < Pet
4 end
5 class Dog < Pet
6 end
7 class LabradorRetriever < Dog
8 end
```

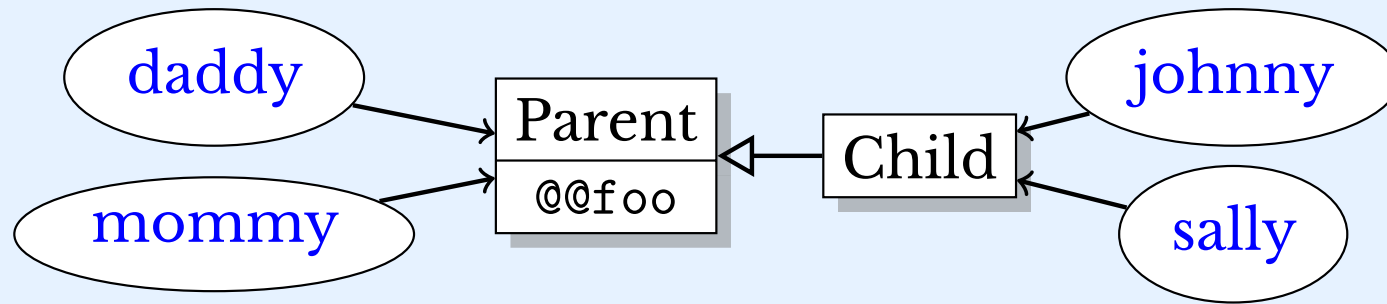


## Kind-Of, Is-A, and Instance-Of



```
1 12.class # Fixnum
2 3.14.class # Float
3 12.is_a? Numeric # true
4 12.is_a? Integer # true
5 12.is_a? Fixnum # true
6 12.kind_of? Numeric # true
7 12.instance_of? Numeric # false
8 12.instance_of? Integer # false
9 12.instance_of? Fixnum # true
```

## Class Variables Are Shared With Subclasses



```
1 class Parent
2   @@foo = []
3   def foo
4     @@foo
5   end
6   def self.foo
7     @@foo
8   end
9 end
10
11 class Child < Parent
12 end
```

## Class Variables Are Shared With Subclasses

```
1 daddy, mommy = Parent.new, Parent.new
2 johnny, sally = Child.new, Child.new
3 Parent.foo << 1
4 Child.foo << 2
5 daddy << 3
6 johnny << 4
7 Parent.foo # [1, 2, 3, 4]
8 Child.foo # [1, 2, 3, 4]
9 daddy.foo # [1, 2, 3, 4]
10 mommy.foo # [1, 2, 3, 4]
11 johnny.foo # [1, 2, 3, 4]
12 sally.foo # [1, 2, 3, 4]
```

## Class Instance Variables Are Not Shared

```
1 class A
2   class << self
3     attr_accessor :x
4   end
5 end
6 class B < A
7 end
8 A.x = :aay
9 B.x = :buzz
10 A.x # :aay
11 B.x # :buzz
12 a = A.new
13 b = B.new
14 a.class.x # :aay
15 b.class.x # :buzz
```

# Modules

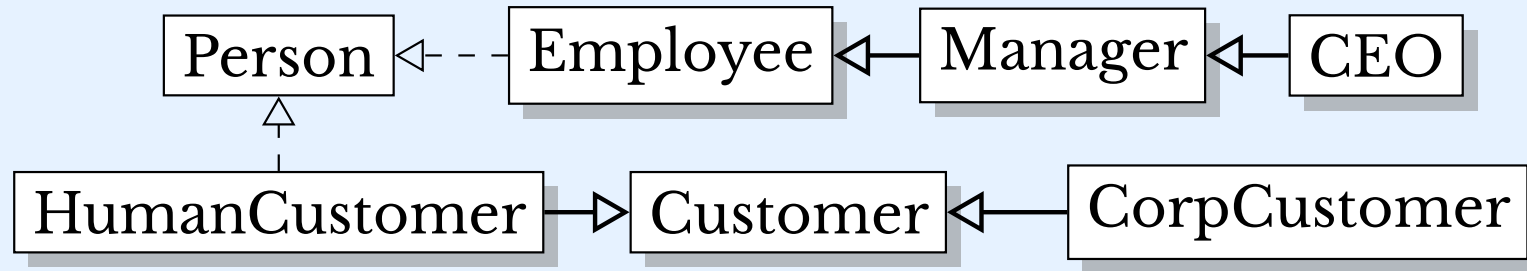
Modules can't be instantiated. They're like classes, but more for libraries of functions.

```
1 module MathStuff
2   BETTER_PI = 3.15
3   class << self
4     def addition x,y # I love typing
5       x+y
6     end
7     def subtraction x,y
8       x-y
9     end
10  end
11 end
12
13 MathStuff.addition 12,44 # 56
14 m = MathStuff.new # NoMethodError: undefined method `new'
```

# Mixins



## Mixins Are Modules Stuffed Into Classes



```
1 module Person
2   attr_accessor :name, :age, :favorite_color
3 end
4 class Employee
5   include Person
6 end
7 class Manager < Employee
8 end
9 class Customer
10  include Person
11 end
```

# Singletons





# Singletons

You almost never actually want one of these.

```
1 require "singleton"
2
3 class ThereCanBeOnlyOne
4   include Singleton
5   attr_accessor :name
6 end
7
8 connor = ThereCanBeOnlyOne.instance # You can't call new.
9 connor.name = "Connor_MacLeod"
10 duncan = ThereCanBeOnlyOne.instance
11 duncan.name = "Duncan_MacLeod"
12 connor.name # "Duncan MacLeod"
13 connor == duncan # true
```

# Eigenclasses

```
1 class Object
2   def eigenclass
3     class << self
4       self
5     end
6   end
7 end
8
9 class A
10 end
11
12 a, b = A.new, A.new
13 a.eigenclass != b.eigenclass # true
14 a.eigenclass.class # Class
15 a.eigenclass.superclass # A
```

# Instance Methods

```
1 class C
2   def initialize x
3     @x = x
4   end
5   def f
6     puts @x
7   end
8 end
9
10 c = C.new "default_stuff"
11 d = C.new "wat?"
12 def d.f
13   puts @x.reverse
14 end
15 c.f # "default_stuff"
16 d.f # "?taw"
```

# Metaclasses

Instance methods *actually* live in the metaclass.

```
1 class C
2   def initialize x
3     @x = x
4   end
5   def f
6     puts @x
7   end
8 end
9 c, d = C.new(13), C.new(13)
10 def c.f
11   "lucky"
12 end
13 c.to_s # "lucky"
14 d.to_s # "13"
15 metaclass = class << c; self; end
```

# Eigenclasses versus Metaclasses

Eigenclasses are sort of the metaclasses of classes.

```
1 class Object
2   def eigenclass
3     class << self
4       self
5     end
6   end
7 end
8
9 class A
10 end
11 a = A.new
12 metaclass = class << a; self; end
```

*Questions?*