

Ruby: Object-Oriented Concepts

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Lecture 9

Classes

- Classes have methods and variables

```
class LightBulb      # name with CamelCase
  def initialize     # special method name
    @state = false  # @ means "instance variable"
  end
  def on?
    @state          # implicit return
  end
  def flip_switch!  # name with snake_case
    @state = !@state
  end
end
```

- Instantiation calls *initialize* method

```
f = LightBulb.new #=> <LightBulb:0x0000e71c2322
                    @state=false>

f.on? #=> false
```

Visibility

- Instance variables are always private
 - Private to *object*, not class
- Methods can be private or public (default)

```
class LightBulb
  private def inside
    ...
  end

  def access_internals(other_bulb)
    inside # ok
    other_bulb.inside # no! inside is private
    self.inside # no explicit recv'r allowed
  end
end
```

Getters/Setters

```
class LightBulb
  def initialize(color, state = false)
    @color = color # not visible outside object
    @state = state # not visible outside object
  end
  def color
    @color
  end
  def state
    @state
  end
  def state=(value)
    @state = value
  end
end
```

Attributes

```
class LightBulb
  def initialize(color, state = false)
    @color = color
    @state = state
  end
  def color
    @color
  end

  attr_accessor :state # name is a symbol

end
```

Attributes

```
class LightBulb
  def initialize(color, state = false)
    @color = color
    @state = state
  end

  attr_reader :color

  attr_accessor :state
end
```

Attributes

```
class LightBulb
  attr_reader :color
  attr_accessor :state
  attr_writer :size

  def initialize(color, state = false)
    @color = color
    @state = state
    @size = 0
  end
end
```

Classes Are Always Open

- A class can always be extended

```
class Street
  def construction ... end
end
```

...

```
class Street
  def repave ... end # Street now has 2 methods
end
```

- Applies to core classes too

```
class Integer
  def log2_of_cube # lg(self^3)
    (self**3).to_s(2).length - 1
  end
end
500.log2_of_cube #=> 26
```


Classes are Always Open (!)

- ❑ Existing methods can be redefined!
- ❑ When done with system code (libraries, core ...) called “monkey patching”
- ❑ Tempting, but... Just Don't Do It

No Overloading

- Method identified by (symbol) name
 - No distinction based on number of arguments

- Approximation: default arguments

```
def initialize(width, height = 10)
  @width = width
  @height = height
end
```

- Better alternative: trailing options hash

```
def initialize(width, options)
```

- Modern alternative: default keyword args

```
def initialize(height: 10, width:)
```

A Class is an Object Instance too

- Even classes are objects, created by :new

```
LightBulb = Class.new do #class LightBulb
  def initialize
    @state = false
  end
  def on?
    @state
  end
  def flip_switch!
    @state = !@state
  end
end
```

Instance, Class, Class Instance

```
class LightBulb
  @state1          # class instance var
  def initialize
    @state2 = ...  # instance variable
    @@state3 = ... # class variable
  end
  def bar          # instance method
    ...           # sees @state2, @@state3
  end
  def self.foo    # class method
    ...           # sees @state1, @@state3
  end
end
```

Inheritance

- Single inheritance between classes

```
class LightBulb < Device
```

```
  ...
```

```
end
```

- Default superclass is Object (which inherits from BasicObject)

- Super calls parent's method

- No args means forward all args

```
class LightBulb < Device
```

```
  def electrify(current, voltage)
```

```
    do_work
```

```
    super # with current and voltage
```

```
  end
```

```
end
```

Modules

- Another container for definitions

```
module Stockable
  MAX = 1000
  class Item ... end
  def self.inventory ... end # utility fn
  def order ... end
end
```

- Cannot, themselves, be instantiated

```
s = Stockable.new # NoMethodError
i = Stockable::Item.new # ok
Stockable.inventory # ok
Stockable.order # NoMethodError
```

Modules as Namespaces

- Modules create independent namespaces
 - cf. packages in Java

- Access contents via scoping (::)

```
Math::PI      #=> 3.141592653589793
```

```
Math::cos 0   #=> 1.0
```

```
widget = Stockable::Item.new
```

```
x = Stockable::inventory
```

```
Post < ActiveRecord::Base
```

```
BookController < ActionController::Base
```

- Style: use dot to invoke utility functions (ie module methods)

```
Math.cos 0   #=> 1.0
```

```
Stockable.inventory
```

Modules are Always Open

- Module contains several related classes
- Style: Each class should be in its own file
- So split module definition

```
# game.rb  
module Game  
end
```

```
# game/card.rb  
module Game  
  class Card ... end  
end
```

```
# game/player.rb  
module Game  
  class Player ... end  
end
```


Modules as “Mixins”

- Another container for method definitions

```
module Stockable
  def order ... end
end
```

- A module can be *included* in a class

```
class LightBulb < Device
  include Stockable, Comparable ...
end
```

- Module's (instance) methods/vars are now (instance) methods/vars for class

```
bulb = LightBulb.new
bulb.order           # from Stockable
if bulb <= old_bulb # from Comparable
```

Requirements for Mixins

- Mixins often rely on certain aspects of classes into which they are included
- Example: Comparable methods use `<=>`

```
module Comparable
  def <(other) ... end
  def <=(other) ... end
end
```
- Enumerable methods use `#each`
- Recall *layering* in SW I/II
 - Class implements kernel methods
 - Module implements secondary methods

Software Engineering

- ❑ All the good principles of SW I/II apply
- ❑ Single point of control over change
 - Avoid magic numbers
- ❑ Client view: abstract state, contracts, invariants
- ❑ Implementers view: concrete rep, correspondence, invariants
- ❑ Checkstyle tool: e.g., rubocop
- ❑ Documentation (YARD or RDoc)
 - Notation for types: yardoc.org/types.html
`@param [String, #read] # either is ok`

Summary

- Classes as blueprints for objects
 - Contain methods and variables
 - Public vs private visibility of methods
 - Attributes for automatic getters/setters
- Metaprogramming
 - Classes are objects too
 - “Class instance” variables
- Single inheritance
- Modules are namespaces and mixins