Introduction to Ruby

CPS353 Internet Programming

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Agenda

- Scripture (Ephesians 6) and Prayer
- Check-in
- Database Design and SQL
  - Class Exercises
- Project Design
- Ruby
- Homework 4

Check-in

- Syllabus update
- Homework 3
- Milestone 3

Database Design and SQL

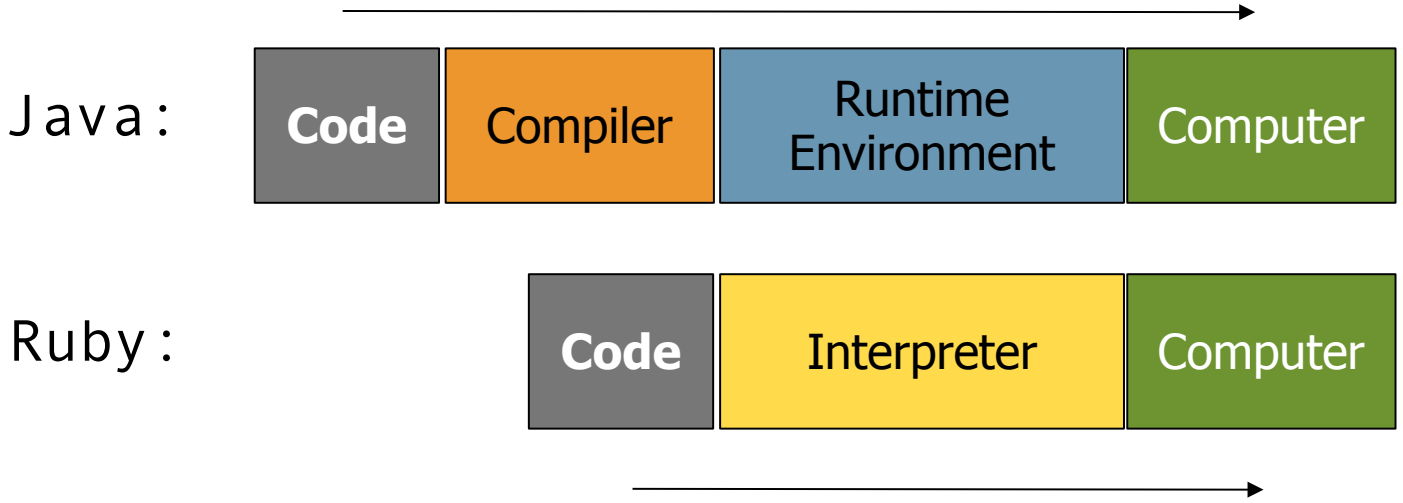
Continued from last week
(starting on slide 60)

What is Ruby?

- Programming Language
- Object-oriented
- Interpreted
- Concise

Interpreted Languages

- Not compiled like Java
- Code is written and then directly executed by an **interpreter**
- Type commands into interpreter and see immediate results



hello_world.rb

```
puts "hello world!"
```

puts vs. print

- "puts" adds a new line after it is done
  - analogous System.out.println()

- "print" does not add a new line
  - analogous to System.out.print()

Running Ruby Programs

- Use the Ruby interpreter

  ruby hello_world.rb

  – "ruby" tells the computer to use the Ruby interpreter
- Interactive Ruby (irb) console

  irb

  – Get immediate feedback
  – Test Ruby features
  – a.ka. REPL (read-evaluate-print loop)

Some Basics

- Ruby code files generally have a .rb extension
- Statements do not end in semi-colons
- New statements start on new lines
- Whitespace and indentation does not matter
  - Convention is to indent 2 spaces for blocks
- Blocks of statements don't use brace delimiters
  - Start with keyword (i.e. if, while, do, etc.)
  - End with "end"
- Parenthesis around method parameters are optional
  - Generally omitted for declarations or short "commands"
  - Help keep parts of longer expressions distinct

Comments

```
# this is a single line comment


=begin
   this is a multiline comment
   nothing in here will be part of the code
=end
```

Variables

- Declaration – No need to declare a "type"
- Assignment – same as in Java
- Example:

```
x = "hello world"        # String
y = 3                    # Fixnum
z = 4.5                  # Float
r = 1..10                # Range
```

Objects

- Everything is an object.
  - Common Types (Classes): Numbers, Strings, Ranges
  - nil, Ruby's equivalent of null is also an object
- Uses "dot-notation" like Java objects
- You can find the class of any variable

```
x = "hello"
x.class          →      String
```

- You can find the methods of any variable or class

```
x = "hello"
x.methods
String.methods
```

Objects (cont.)

- There are many methods that all Objects have
- Include the "?" in the method names, it is a Ruby naming convention for boolean methods
  - nil?
  - eql?/equal?
  - ==, !=, ===
  - instance_of?
  - is_a?
  - to_s

Numbers

- Numbers are objects
- Different Classes of Numbers
  - FixNum, Float

```
3.eql?2      →   false
-42.abs      →   42
3.4.round    →   3
3.6.round    →   4
3.2.ceil     →   4
3.8.floor    →   3
3.zero?      →   false
```

String Methods

"hello world".length	→	11
"hello world".nil?	→	false
"".nil?	→	false
"ryan" > "kelly"	→	true
"hello_world!".instance_of?String	→	true
"hello" * 3	→	"hellohellohello"
"hello" + " world"	→	"hello world"
"hello world".index("w")	→	6

Special method name characters

- Method names can sometimes end with certain punctuation marks
  - These are actually part of the method name
- ? – returns a Boolean value

```
"0".zero?              # true
"aardvark".nil?        # false
```

- ! – performs some permanent change

```
line = "a line\n"
line.chomp!            # line is now "a line"
```

String Literals

- Single quoted

  puts ‘aardvark\’s “fun” class’ # aardvark’s fun class

- Double quoted

  puts “aardvark’s\”fun\” class” # aardvark’s fun class

  – Interpolation

  adj = “fun”

  puts “aardvark\’s #{adj} class” # aardvark’s fun class

Operators and Logic

- Same as Java
  - Multiplication, division, addition, subtraction, etc.
- Also same as Java AND Python (WHA?!)
  - "and" and "or" as well as "&&" and "||"
- Fun things happen with Strings
  - String concatenation (+)
  - String multiplication (*)
- There are many ways to solve a problem in Ruby
  - TMTOWTDI, to borrow from Perl

if/elsif/else/end

- Must use "elsif" instead of "else if"
- Notice use of "end". It replaces closing curly braces in Java
- Example:

```
if (age < 35)
   puts "young whipper-snapper"
elsif  (age < 105)
   puts "80 is the new 30!"
else
   puts "wow… gratz..."
end
```

Inline "if" statements

- Original if-statement

```
if age < 105
  puts "don't worry, you are still young"
end
```

- Inline if-statement

```
puts "don't worry, you are still young" if age < 105
```

for-loops

- for-loops can use ranges
- Example 1:

```
for i in 1..10
        puts i
end
```

- Can also use blocks (often more idiomatic)

```
3.times do
  puts ”Aardvark! "
end
```

for-loops and ranges

- You may need a more advanced range for your for-loop
- Bounds of a range can be expressions
- Example:

```
for i in 1..(2*5)
        puts i
end
```

while-loops

- Can also use blocks
- Cannot use "i++"
- Example:

```
i = 0
while i < 5
        puts i
        i += 1
end
```

unless

- "unless" is the logical opposite of "if"

- Example:

```
unless (age >= 105)                # if (age < 105)
   puts "young."
else
   puts "old."
end
```

until

- Similarly, "until" is the logical opposite of "while"
- Can specify a condition to have the loop stop (instead of continuing)
- Example

```
i = 0
until (i >= 5)      # while (i < 5), parenthesis not required
        puts i
        i += 1
end
```

Methods

- Structure

  def ***method_name***(***parameter1***, ***parameter2***, **…**)

  statements

  end

- Simple Example:

```
def print_overused_animal
  puts ”Aardvark"
end
```

Parameters

- No class/type required, just name them!
- Example:

```
def cumulative_sum(num1, num2)
   sum = 0
   for i in num1..num2
            sum = sum + i
   end
   return sum
end

# call the method and print the result
puts(cumulative_sum(1,5))
```

Return

- Ruby methods return the value of the last statement in the method, so…

```
def add(num1, num2)
  sum = num1 + num2
  return sum
end
```

can become

```
def add(num1, num2)
  num1 + num2
end
```

User Input

- "gets" method obtains input from a user
- Example

```
name = gets
puts "hello " + name + "!"
```

- Use chomp to get rid of the extra line

```
puts "hello" + name.chomp + "!"
```

- chomp removes trailing new lines

Changing types

- You may want to treat a String a number or a number as a String
  - to_i – converts to an integer (FixNum)
  - to_f – converts a String to a Float
  - to_s – converts a number to a String
- Examples

"3.5".to_i	→	3
"3.5".to_f	→	3.5
3.to_s	→	"3"

Constants

- In Ruby, constants begin with an Uppercase
- They should be assigned a value at most once
- This is why local variables begin with a lowercase
- Example:

```
Width = 5
def square
  puts  ("*" * Width + "\n") * Width
end
```

Arrays

- Similar to PHP, Ruby arrays…
  - Are indexed by zero-based integer values
  - Store an assortment of types within the same array
  - Are declared using square brackets, [], elements are separated by commas
- Example:

```
a = [1, 4.3, "hello", 3..7]
a[0]    →    1
a[2]    →    "hello"
```

Arrays

- You can assign values to an array at a particular index, just like PHP
- Arrays increase in size if an index is specified out of bounds and fill gaps with nil
- Example:

```
a = [1, 4.3, "hello", 3..7]
a[4] = "goodbye"
a        →        [1, 4.3, "hello", 3..7, "goodbye"]
a[6] = "hola"
a        →    [1, 4.3, "hello", 3..7, "goodbye", nil, "hola"]
```

<< Method

- <<() appends a value to an array

```
ages = []
for person in @people
  ages << person.age
end
```

Shortcut for an array of words

- Instead of this:

```
a = [ ‘do’, ‘re’, ‘mi’ ]
```

- Can omit quotes for single-word elements like this:

```
a = %w{ do re me }
```

Negative Integer Index

- Negative integer values can be used to index values in an array

- Example:

```
a = [1, 4.3, "hello", 3..7]
a[-1]          →    3..7
a[-2]          →    "hello"
a[-3] = 83.6
a              → [1, 83.6,  "hello", 3..7]
```

Hashes

- Arrays use integers as keys for a particular values (zero-based indexing)
- Hashes, also known as "associative arrays", have Objects as keys instead of integers
- Declared with curly braces, {}, and an arrow, "=>", between the key and the value
- Example:

```
h = {"greeting" => "hello", "farewell" =>"goodbye"}
h["greeting"]          →      "hello"
```

Sorting

a = [5, 6.7, 1.2, 8]

a.sort → [1.2, 5, 6.7, 8]

a → [5, 6.7, 1.2, 8]

a.sort! → [1.2, 5, 6.7, 8]

a → [1.2, 5, 6.7, 8]

a[4] = "hello" → [1.2, 5, 6.7, 8, "hello"]

a.sort → Error: comparison of Float with String failed

h = {"greeting" => "hello", "farewell" =>"goodbye"}

h.sort → [["farewell", "goodbye"], ["greeting", "hello"]]

Symbols

redirect_to :action => ‘edit’, :id => 1234

- A string literal that is “magically” turned into a constant
  - Looks like a variable name prefixed with a colon
  - “the thing named” (i.e. the thing named “id”)
- Used to
  - “Name” method parameters
  - Look up things in hashes

Blocks

- Blocks are simply "blocks" of code
- They are defined by curly braces, {}, or a do/end statement
- They are used to pass code to methods and loops

Blocks

- In Java, we were only able to pass parameters and call methods
- In Ruby, we can pass code through blocks
- We saw this earlier, the times() method takes a block:

```
3.times { puts "hello" }    # the block is the code in the {}
```

Blocks and Parameters

- Blocks can also take parameters
- For example, our times() method can take a block that takes a parameter. It will then pass a parameter to the block
- Example

```
3.times {|n| puts "hello" + n.to_s}
```

- Here "n" is specified as a parameter to the block through the vertical bars "|"

Yield

- yield statements go hand-in-hand with blocks
- The code of a block is executed when a yield statement is called

Yield Examples

Code:

```
def demo_yield
    puts "BEGINNING"
    yield
    puts "END"
end
demo_yield { puts "hello" }

def demo_yield2
    puts "BEGINNING"
    yield
    puts "MIDDLE"
    yield
    puts "END"
end
demo_yield2{ puts "hello" }
```

Output:

```
BEGINNING
hello
END

BEGINNING
hello
MIDDLE
hello
END
```

Yield

- A yield statement can also be called with parameters that are then passed to the block
- Example:

```
3.times { |n| puts n}
```

- The "times" method calls yield with a parameter that we ignored when we just printed "hello" 3 times, but shows up when we accepted a parameter in our block

Parameters, Blocks, and Yield

- Example:

```
def demo_yield3
  yield 2
  yield "hello"
  yield 3.7
end
demo_yield3 { |n| puts n * 3}
```

- "n" is the value passed by yield to the block when yield is called with arguments

Iterators

- An iterator is simply "a method that invokes a block of code repeatedly" (*Pragmatic Programmers' Guide*)
- Iterator examples: Array.find, Array.each, Range.each
- Examples:

```
[1,2,3,4,5].find{ |n| Math.sqrt(n).remainder(1)==0}    # finds perfect square
[2,3,4,5].find{ |n| Math.sqrt(n).remainder(1)==0}      # finds perfect square
[1,2,3,4,5].each { |i| puts i }                        #prints 1 through 5
[1,2,3,4,5].each { |i| puts i * i }      #prints 1 squared, 2 squared…, 5squared
(1..5).each{ |i| puts i*i }              #prints 1 squared, 2 squared…, 5squared
```

Iterators and Loops

- Common to use iterators instead of loops
- Avoids off-by-one errors
- Built-in iterators have well defined behavior
- Examples

```
0.upto(5) { |x| puts x }        # prints 0 through 5
0.step(10, 2) { |x| puts x }    # 0, 2, 4, 6, 8, 10
0.step(10,3) { |x| puts x }     # 0, 3, 6, 9
```

for...in

- Similar to PHP's foreach:
  - PHP

```
$prices = array(9.00, 5.95, 12.50)
foreach($prices as $price){
   print "The next item costs $price\n"
}
```

  - Ruby

```
prices = [9.00, 5.95, 12.50]
for price in prices
   puts "The next item costs " + price.to_s
end
```

for...in

- Previous example

```
prices = [9.00, 5.95, 12.50]
for price in prices
   puts "The next item costs " + price.to_s
end
```

- Can also be written

```
prices = [9.00, 5.95, 12.50]
prices.each do |price|
   puts "The next item costs " + price.to_s
end
```

Strings

- Strings can be referenced as Arrays
- The value returned is the a Integer equivalent of the letter at the specified index
- Example:

```
s = "hello"
s[1]        →   101
s[2]        →   108
s[1].chr    →   "e"
s[2].chr    →   "l"
```

More Strings

- chomp – returns a new String with the trailing newlines removed

- chomp! – same as chomp but modifies original string

More Strings

- split(delimiter) – returns an array of the substrings created by splitting the original string at the delimiter

- slice(starting index, length) – returns a substring of the original string beginning at the "starting index" and continuing for "length" characters

Strings Examples

```
s = "hello world\n"
s.chomp          → "hello world"
s                → "hello world\n"
s.chomp!         → "hello world"
s                → "hello world"
s.split(" ")     → ["hello", "world"]
s.split("l")     → ["he", "", "o wor", "d"]
s.slice(3,5)     → "lo wo"
s                → "hello world"
s.slice!(3,5)    → "lo wo"
s                → "helrld"
```

Iterating over String characters

Code	Output
]"hello”].each {|n| puts n}	"hello"
"hello".each_byte {|n| puts n}	104 101 108 108 111
"hello".each_char{|n| puts n}	h e l l o

Files as Input

- To read a file, call File.open(), passing it the the path to your file
- Passing a block to File.open() yields control to the block, passing it the opened file
- You can then call gets() on the file to get each line of the file to process individually
  - This is analogous to Java's Scanner's .nextLine()

Files as Input

- Example (bold denotes variable names)

```
File.open("file.txt") do |input|   # input is the file passed to our block
   while line = input.gets          # line is the String returned from gets()
         # process line as a String within the loop
         tokens = line.split(" ")
   end
end
```

Output to Files

- To output to a file, call File.open with an additional parameter, "w", denoting that you want to write to the file

```
File.open("file.txt", "w") do |output|
  output.puts "we are printing to a file!"
end
```

Writing from one file to another

- If a block is passed, File.open yields control to the block, passing it the file.

- To write from one file to another, you can nest File.open calls within the blocks

Writing from one file to another

```
File.open("input_file.txt") do |input|
   File.open("output_file.txt", "w") do |output|
        while line = input.gets
                output.puts line
        end
   end
end
```

Classes and Objects

- Class names start with a capital letter
- Instantiation

```
a = Aardvark.new
a.class         # Aardvark
a.methods  # list of all methods on Aardvark object
Aardvark.method # list of all Aardvark class methods
```

Constructors

- Writing a new class is simple!
- Example:

```
class Point
end
```

- But we may want to initialize state (constructor)
  - initialize()
  - Example:

```
class Point
  def initialize(x, y)
        @x = x          # the convention for instance variables
        @y = y          # is @parameter_name
  end
end
```

Instantiating New Objects

- We instantiate a new object by calling the new() method on the class we want to instantiate
- Example

  p = Point.new(2,3
- How do we get the @x of p?

  p.@x?

  p.x?

Accessing State

- Instance variables are private by default
- The instance variables for our Point class are

  @x, @y

- To access them, we must write methods that return their value
  - Remember "encapsulation" from your OO class?

Accessing State

```
class Point
   def initialize(x, y)
            @x = x
            @y = y
   end

   def get_x
            @x
   end
end

p = Point.new(2, 3)
puts p.get_x        # get value of x by calling a method
```

Accessing State

```
class Point
   def initialize(x, y)
            @x = x
            @y = y
   end

   def x
            @x
   end
end

p = Point.new(2, 3)
puts p.x  # get value of instance variable by calling a method
```

Accessing State

- We do not need to write these methods by hand
- Example:

```
class Point
  attr_reader :x, :y
  def initialize(x, y)
        @x = x
        @y = y
  end
end
```

- What if we want to assign values?

Accessing State

- To assign a value to @x, we can write a method
- Example:

```
def set_x(x)
  @x = x
end
p.set_x(7)
```

- Similarly we can use attr_writer

```
attr_writer :x, :y
```

Accessing State

- If we want to read and write all of our instance variables, we can combine attr_reader and attr_writer to simplify our class, replacing them with attr_accessor

```
class Point
  attr_accessor :x, :y
  def initialize(x, y)
      @x = x
      @y = y
  end
end
```

Class vs. Instance Methods

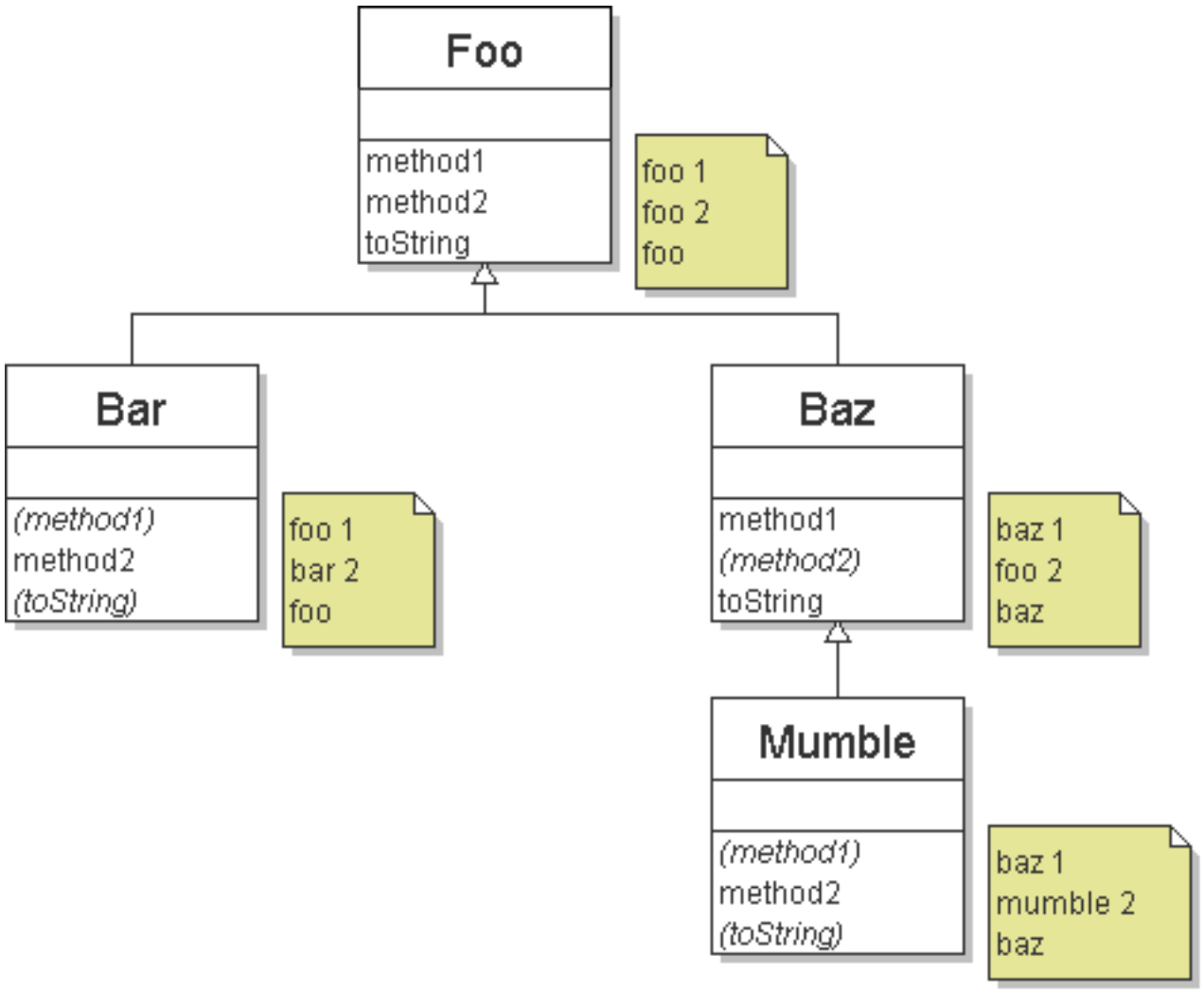
- Class method called on the class (name preceded with “self.” in definition
- Instance method called on an object

```
class Foo
   …
   def self.bar
         puts “class method
   end
   def baz
         puts “instance method”
   end
end
```

Inheritance

- Ruby supports single inheritance
- This is similar to Java where one class can inherit the state and behavior of exactly one other class
- The parent class is known as the superclass, the child class is known as the subclass

Inheritance



Public and Private Methods

- Methods are public by default
- Private methods are declared the same way as public methods (no keyword at the beginning of method like Java)
- Private methods are designated by an "area" of private methods
- They keyword "private" designates this area
- Any methods after "private" are private methods

Public and Private Methods

- Public – any class can use the methods
- Private – only this particular object can use these methods

- There is a middle ground… methods can be "protected"
- Protected – only objects of this class or its subclasses can use these methods

Modifying Class Behavior

- Ruby allows us to add or modify functionality to ANY class
- This includes built-in classes like Fixnum and String
- Lets allow Strings to add any object to it without having to say to_s

```
"hello" + 3                    # instead of "hello" + 3.to_s
```

Modules

- Like classes, modules have methods, constants, etc.
- Unlike classes, they cannot be instantiated
- Define a unique namespace for data/methods
- Allow sharing functionality between classes
  - A class *mixes in* a modules to take on its data and methods
- Use require to import classes and modules

Example

```
class CreateProducts < ActiveRecord::Migration
  def change
    create_table :products do |t|
      t.string :title
      t.text :description
      t.string :image_url
      t.decimal :price, precision: 8, scale: 2
      t.timestamps
    end
  end
end
```

Ruby Idioms

- Methods such as empty? And empty!
- a || b – return a default value (b) if the first (a) is not set
- a ||= b – set a default value (b) if the first (a) is not set
- obj = self.new – returns an object of the "correct" type in a class hierarchy

Milestone 4