Freestanding Methods

Basics

Where's the class?

Domain and range in Ruby

Varying numbers of arguments

Method definition

Here is a Ruby version of a simple method:

```
def double(x)
   return x * 2
end
```

The keyword def indicates that a method definition follows. Next is the method name. The parameter list follows.

If the end of a method is reached without encountering a return, the value of the last expression becomes the return value. Here is an equivalent definition:

```
def double(x)
   x * 2
end
```

If no arguments are required, the parameter list can be omitted

```
def hello
   puts "Hello, world!"
end
```


Method definition, continued

One way to get a method into irb is to use load:

```
% cat double.rb
def double(x)
   x * 2
end

% irb --prompt simple
>> load "double.rb"
=> true

>> double(5)
=> 10
```


Method definition, continued

Alternatively, we can type a definition directly into irb:

```
% irb
irb(main):001:0> def double(x)
irb(main):002:1>     x * 2
irb(main):003:1> end
=> nil

irb(main):004:0> double(5)
=> 10

irb(main):005:0>
```

Note that irb was run without "--prompt simple". The default prompt includes a line counter and a nesting depth.

If double is a method, where's the class?

You may have noticed that even though we claim to be defining a method named double, there's no class in sight.

In Ruby, methods can be added to a class at run-time. A freestanding method defined in irb or found in a file is associated with an object referred to as "main", an instance of Object. At the top level, the name self references that object.

```
>> [self.class, self.to_s]
=> [Object, "main"]            # The class of self and a string representation of it.

>> methods_b4 = self.methods
=> ["methods", "popb", ...lots more...]

>> def double(x); x * 2 end
=> nil

>> self.methods - methods_b4
=> ["double"]
```

We can see that self has one more method (double) after double is defined.

Domain and range in Ruby

For reference:

```
def double(x)
   x * 2
end
```

For the ML analog of double the domain and range are the integers. (int -> int)

What is the domain and range of double in Ruby?

Domain and range in Ruby, continued

Problem: Write a method polysum(L) that produces a "sum" of the values in L.

Examples:

```
>> polysum([1,3,5])
=> 9

>> polysum([1.1,3.3,5.5])
=> 9.9

>> polysum(["one", "two"])
=> "onetwo"

>> polysum([["one"], [2,3,4], [[1],[1..10]]])
=> ["one", 2, 3, 4, [1], [1..10]]
```

How can we describe the domain and range of polysum?

Varying numbers of arguments

Unlike some scripting languages, Ruby considers it to be an error if the wrong number of arguments is supplied to a routine.

```
def wrap(s, wrapper)
   wrapper[0,1] + s + wrapper[1,1]
end

>> wrap("testing", "<>")
=> "<testing>"

>> wrap("testing")
ArgumentError: wrong number of arguments (1 for 2)

>> wrap("testing", "<", ">")
ArgumentError: wrong number of arguments (3 for 2)
```

Contrast: Icon supplies &null (similar to Ruby's nil) for missing arguments. Extra arguments are ignored.

Varying numbers of arguments, continued

Ruby does not allow the methods of a class to be overloaded. Here's a Java-like approach that **DOES NOT WORK**:

```
def wrap(s)
   wrap(s, "()")
end

def wrap(s, wrapper)
   wrapper[0,1] + s + wrapper[1,1]
end
```

The imagined intention is that if wrap is called with one argument it will call the two-argument wrap with "()" as a second argument.

In fact, the second definition of wrap simply replaces the first. (Last def wins!)

```
>> wrap "x"
ArgumentError: wrong number of arguments (1 for 2)

>> wrap("testing", "[]")
=> "[testing]"
```


Varying numbers of arguments, continued

There's no intra-class method overloading but Ruby does allow default values to be specified for arguments:

```
def wrap(s, wrapper = "()")
   wrapper[0,1] + s + wrapper[1,1]
end

>> wrap("x", "<>")
=> "<x>"

>> wrap("x")
=> "(x)"
```


Varying numbers of arguments, continued

Any number of defaulting arguments can be specified. Imagine a method that creates a window:

```
def make_window(height = 500, width = 700,
      font = "Roman/12", upper_left = 0, upper_right = 0)
   ...
end
```

A variety of calls are possible. Here are some:

```
make_window

make_window(100, 200)

make_window(100, 200, "Courier/14")
```

Here's something that **DOES NOT WORK**:

```
make_window( , , "Courier/14")      Leading arguments can't be omitted!
```


Sidebar: A study in contrast

Different languages approach overloading and default arguments in various ways. Here's a sampling:

Java	Overloading; no default arguments
C++	Overloading and default arguments
Ruby	No overloading; default arguments
Icon	No overloading; no default arguments; use an idiom

Here is wrap in Icon:

```
procedure wrap(s, wrapper)
      /wrapper := "()"    # if wrapper is &null, assign "()" to wrapper
      return wrapper[1] || s || wrapper[2]
end
```

Varying numbers of arguments, continued

It can be useful to have a method take an arbitrary number of arguments. printf is a good example.

Here's a Ruby method that accepts any number of arguments and simply prints them:

```
def showargs(*args)

   printf("%d arguments:\n", args.size)

   for i in 0...args.size do                    # a...b is a to b-1
         printf("#%d: %s\n", i, args[i])
      end
end
```

If a parameter is prefixed with an asterisk, a list is made of any remaining arguments.

```
>> showargs(1, "two", 3.0)
3 arguments:
#0: 1
#1: two
#2: 3.0
```


Varying numbers of arguments, continued

Problem: Modify polysum so that this works:

```
>> polysum(1,2,3,4)        # Instead of polysum([1,2,3,4])
=> 10
```

Problem: Write a method printf0 that's like printf but simply interpolates argument values as a string (use to_s) where a percent sign is found:

```
>> printf0("x = %, y = %, z = %\n", 10, "ten", "z")
x = 10, y = ten, z = z
=> 23

>> printf0("testing\n")
testing
=> 8
```


Varying numbers of arguments, continued

Sometimes we want to call a method with the values in a list:

```
>> def add(x,y) x + y end

>> pair = [3,4]

>> add(pair[0], pair[1])
=> 7
```

Here's an alternative:

```
>> add(*pair)
=> 7
```

In a method call, prefixing a list value with an asterisk causes the list values to substituted for the parameters.

Speculate: What will be the result of add(*[1,2,3])?

Varying numbers of arguments, continued

Recall make_window:

```
def make_window(height = 500, width = 700,
      font = "Roman/12", upper_left = 0, upper_right = 0)
      ...printf to echo the arguments...
end
```

Results of list-producing methods can be passed easily to make_window:

```
>> where = get_loc(...whatever...)
=> [50, 50]

>> make_window(100, 200, "Arial/8", *where)
make_window(height = 100, width = 200, font = Arial/8, at = (50, 50)

>> win_spec = get_spec(...whatever...)
=> [100, 200, "Courier/9"]

>> make_window(*win_spec)
make_window(height = 100, width = 200, font = Courier/9, at = (0, 0)
```

Speculate: Will make_window(*[300,400], "x", *[10,10]) work?