Ruby Basics

Acknowledgment

- Some slides of this presentation is created from the following online resources
  - http://en.wikibooks.org/wiki/Ruby_Programming

Topics (Page 1)

- What is Ruby?
- Ruby naming convention
- Interactive Ruby (IRB)
- Ruby object
- Ruby types
  - String, Hash, Symbol
- Ruby class
- Inheritance

Topics (Page 2)

- Methods
  - Arguments, Visibility, Method with a ! (bang)
- Variables
- Modules
- Reserved keywords
- Regular expression
- Control structures
- Exception handling

What is Ruby?

Ruby is...

A dynamic, open source programming language with a focus on simplicity and productivity. It has an elegant syntax that is natural to read and easy to write.

http://www.ruby-lang.org

Ruby as a Language

- Interpreted
- Dynamically typed
- Optimized for people
  - Easy to read and write
  - Powerful
  - Fun
- Everything is an object
  - There is no primitives

Ruby Language History

- Created 1993 by Yukihiro “Matz” Matsumoto
  - “More powerful than Perl and more OO than Python”
- Ruby 1.8.x is current, 1.9 is in development to become 2.0

Ruby Naming Conventions

Ruby Naming Conventions

- Ruby file - *.rb* suffix
  - *myprog.rb*
- Class & Module names – MixedCase
  - *MyClass*
- methods - lower case with underscores
  - *my_own_method*
- local variables – lower case with underscores (same as methods)
  - *my_own_variable*
- Instance variables - @ prefix to variable name
  - *@my_instance_variable*

Ruby Naming Conventions

- Class variables – @@ prefix to variable name
  - *@@my_class_variable*
- Global variables - $ prefix to variable name
  - *$my_global_variable*
- Constants
  - *UPPER_CASE*

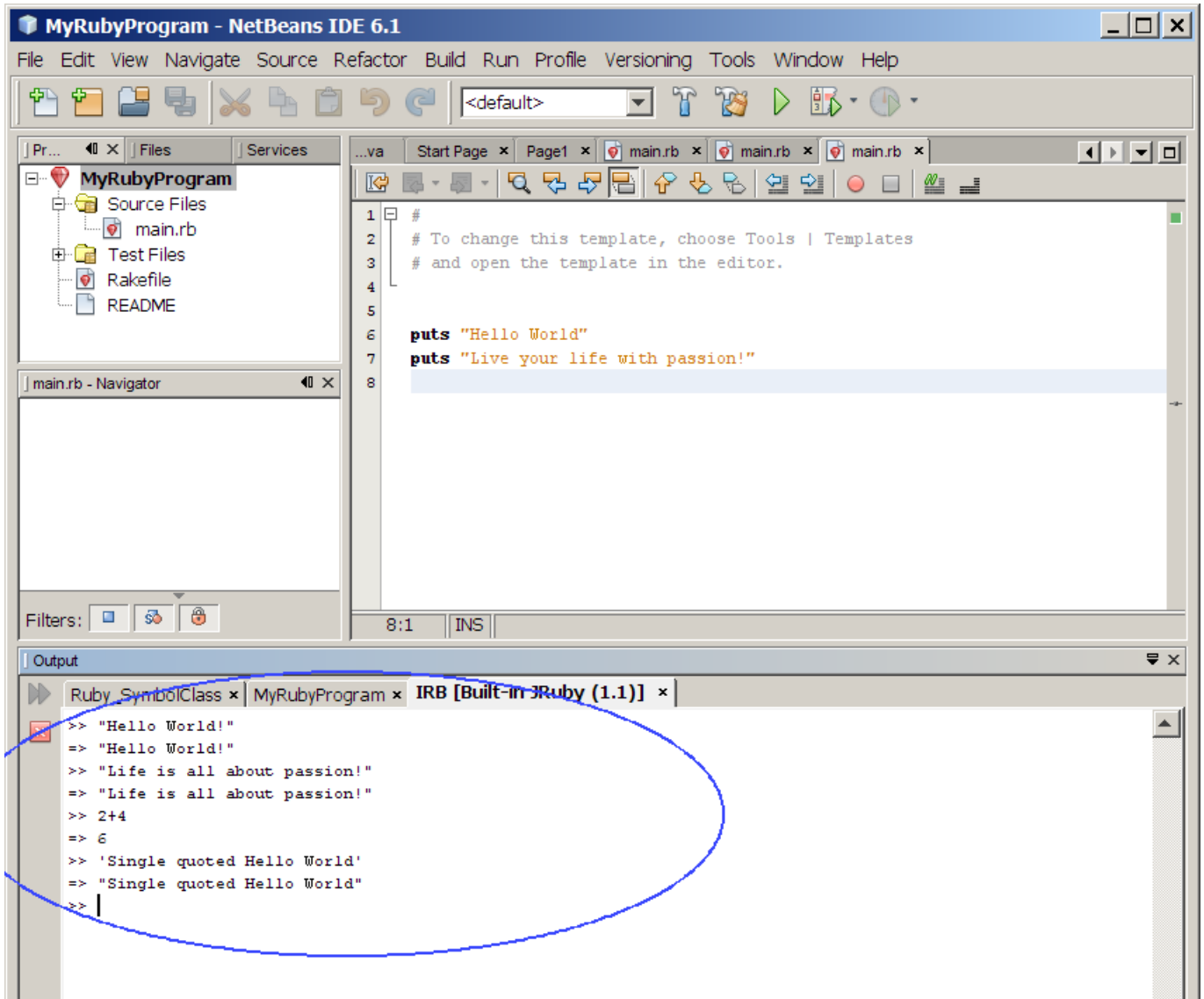
IRB (Interactive Ruby)

IRB (Interactive Ruby)

- When learning Ruby, you will often want to experiment with new features by writing short snippets of code. Instead of writing a lot of small text files, you can use *irb*, which is Ruby's interactive mode.
- You can use *irb* at the command line

```
$ irb --simple-prompt
>> 2+2
=> 4
>> 5*5*5
=> 125
>> exit
```

IRB in NetBeans



JRuby IRB at the Command line

- It is *jirb* under <NetBeans-Install-Dir>/ruby2/jruby-1.1/bin directory

```
C:\Program Files\NetBeans 6.1\ruby2\jruby-1.1\bin>jirb
irb(main):001:0> puts "life is good"
life is good
=> nil
irb(main):002:0> puts 3+4
7
=> nil
irb(main):003:0> exit
```

JRuby IRB Console (Swing app)

- It is *jirb-swing* under <NetBeans-Install-Dir>/ruby2/jruby-1.1/bin directory

  C:\Program Files\NetBeans 6.1\ruby2\jruby-1.1\bin>jirb-swing

Ruby Object

In Ruby, Everything is an Object

- Like Smalltalk, Ruby is a pure object-oriented language — everything is an object.
- In contrast, languages such as C++ and Java are hybrid languages that divide the world between objects and primitive types.
  - The hybrid approach results in better performance for some applications, but the pure object-oriented approach is more consistent and simpler to use.

What is an Object?

- Using Smalltalk terminology, an object can do exactly three things.
  - Hold state, including references to other objects.
  - Receive a message, from both itself and other objects.
  - In the course of processing a message, send messages, both to itself and to other objects.
- If you don't come from Smalltalk background, it might make more sense to rephrase these rules as follows:
  - An object can contain data, including references to other objects.
  - An object can contain methods, which are functions that have special access to the object's data.
  - An object's methods can call/run other methods/functions.

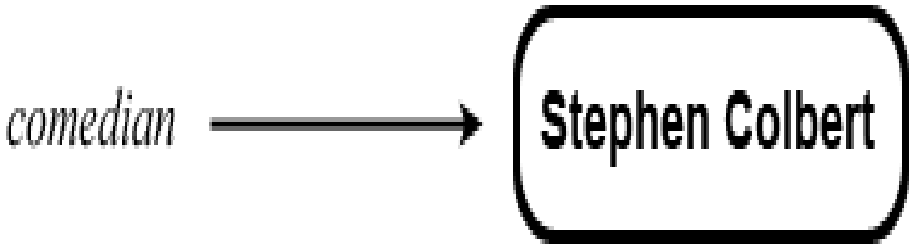
In Ruby, Everything Is An Object

- 'Primitives' are objects
  - *-1.abs*
- nil is an object
  - *nil.methods*
- Classes are objects
  - *Song.new* – invoking the *new* class method on 'Song' class
  - Create instances of themselves
- Code blocks are objects
  - They can be pass around, even as parameters
  - Also known as closure

Variables and Objects

- Create a String object containing the text "Stephen Colbert". We also told Ruby to use the variable *comedian* to refer to this object. (Works the same as in Java)

```
>> comedian = "Stephen Colbert"
=> "Stephen Colbert"
```



Ruby Types

Ruby Types

- String
- Number
- Symbol
- Array
- Hash

Ruby Types:
Strings

String Literals

- One way to create a String is to use single or double quotes inside a Ruby program to create what is called a string literal

```
puts 'Hello world'
puts "Hello world"
```

- Double quotes allow you to embed variables or Ruby code inside of a string literal – this is commonly referred to as interpolation.

```
def my_method(name)
    puts "Your name is #{name}"
end
```

String Literals: Interpolation

- Notation
  - #{expression}
- Expression can be an arbitrary Ruby expression
- If variable that is referenced by #{expression} is not available (has not been assigned), a NameError exception will be raised:

"trying to print #{undefined} variable"

NameError: undefined local variable or method `undefined' for main:Object

Escape Sequences

- \" – double quote
- \\ – single backslash
- \a – bell/alert
- \b – backspace
- \r – carriage return
- \n – newline
- \s – space
- \t – tab

Escape Sequences

```
puts "Hello\t\tworld"
puts "Hello\b\b\b\b\bGoodbye world"
puts "Hello\rStart over world"
puts "1. Hello\n2. World”
```

puts and print

- *puts* automatically prints out a newline after the text

```
>> puts "Say", "hello"
Say
hello
```

- *print* function only prints out a newline if you specify one

```
>> print "Say", "hello", "\n"
Sayhello
```

% Notation

- *%w* causes breaks in white space to result in an string array
  - %w(a b c)
  - => ["a", "b", "c"]

Ruby Types:
Symbols

What is Symbol?

- A Ruby symbol is the internal representation of a name.
- It is a class in Ruby language

  :my_value.class #=> Symbol
- You construct the symbol for a name by preceding the name with a colon.

  :my_symbol
- Atomic, immutable and unique
  - Can't be parsed or modified
  - All references to a symbol refer to the same object

    :my_value.equal?(:my_value) #=> true

    "my_value".equal?("my_value") #=> false

Symbols vs. Strings

- Symbols are always interchangeable with strings
  - In any place you use a string in your Ruby code, you can use a symbol
- Important reasons to use a symbol over a string
  - If you are repeating same string many times in your Ruby code, let's say 10000 times, it will take 10000 times of memory space of the string while if you are using a symbol, it will take a space for a single symbol
- Minor reasons to use a symbol over a string
  - Symbol is easier to type than string (no quotes to type)
  - Symbol stands out in the editor
  - The different syntax can distinguish keys from values in hash
    - `:name => 'Brian'`

Ruby Types:
Hash

Hash

- Hashes are basically the same as arrays, except that a hash not only contains values, but also keys pointing to those values.
- Each key can occur only once in a hash.
- A hash object is created by writing *Hash.new* or by writing an optional list of comma-separated key => value pairs inside curly braces

```
hash_one   = Hash.new
hash_two   = {}                          # shorthand for Hash.new
hash_three = {"a" => 1, "b" => 2, "c" => 3}
```

Hash and Symbol

- Usually Symbols are used for Hash keys (allows for quicker access), so you will see hashes declared like this:

```
hash_sym   = { :a => 1, :b => 2, :c => 3}
```

Where Do Symbols Typically Used?

- Symbols are often used as
  - Hash keys (:name => 'Brian', :hobby => 'golf')
  - Arguments of a method (:name, :title)
  - Method names (:post_comment)
- Symbols are used in Rails pervasively

Ruby Class

Ruby Classes

- Every object in Ruby has a class. To find the class of an object, simply call that object's *class* method.

```
"This is a string".class                  #=> String
9.class                                   #=> Fixnum
["this","is","an","array"].class          #=> Array
{:this => "is", :a => "hash"}.class       #=> Hash
:symbol.class                             #=> Symbol
```

Defining a Class

- Use *class* keyword

```
class Chocolate
    def eat
        puts "That tasted great!"
    end
end
```

Instantiation of an Object

- An object instance is created from a class through the a process called instantiation.
- In Ruby this takes place through a Class method *new*.

```
an_object = MyClass.new(parameters)
```

- This function sets up the object in memory and then delegates control to the *initialize* function of the class if it is present. Parameters passed to the new function are passed into the *initialize* function.

```
class MyClass
  def initialize(parameters)
  end
end
```

Class Example

- Simple RocketShip Class

```
class RocketShip  < Object
  attr_accessor :destination

  def initialize(destination)
    @destination = destination
  end

  def launch()
    "3, 2, 1 Blast off!"
  end
end
```

Class Example

- Single Inheritance

```
class RocketShip  < Object  #  < Object is optional like in Java
  attr_accessor :destination

  def initialize(destination)
    @destination = destination
  end

  def launch()
    "3, 2, 1 Blast off!"
  end
end
```

Class Example

- Constructors in Ruby are named initialize

```
class RocketShip  < Object
  attr_accessor :destination

  def initialize(destination)
    @destination = destination
  end

  def launch()
    "3, 2, 1 Blast off!"
  end
end

# new() allocates a RocketShip instance and initialize()
# initializes that instance
r = RocketShip.new('Netptune')
```

Class Example

- Attributes are easily defined

```
class RocketShip  < Object
  #  No need to define getter and setter for an attribute
  attr_accessor :destination

  def initialize(destination)
    @destination = destination
  end

  def launch()
    "3, 2, 1 Blast off!"
  end
end

r = RocketShip.new
r.destination = 'Saturn'
```

Ruby Class: Inheritance

Inheritance

- A class can inherit functionality and variables from a superclass, sometimes referred to as a parent class or base class. (Same in Java)
- Ruby does not support multiple inheritance and so a class in Ruby can have only one superclass. (Same in Java)
- All non-private variables and functions are inherited by the child class from the superclass. (Same in Java)

Overriding a method

- If your class overrides a method from parent class (superclass), you still can access the parent's method by using 'super' keyword

```
class ParentClass
  def a_method
    puts 'b'
  end
end

class ChildClass < ParentClass
  def a_method
    super           # Call a_method of a parent class
    puts 'a'
  end
end

instance = ChildClass.new
instance.a_method
```

Variables

Types of Variables

- Local variables
- Instance variables
- Class variables
- Global variables
- Pre-defined variables

Local Variables

- A local variable is only accessible in the context where you define it (usually in a method, be it class or instance method). For example:

```
i0 = 1
loop {
  i1 = 2
  print defined?(i0), "\n"     # "i0" was initialized in the ascendant block
  print defined?(i1), "\n"     # "i1" was initialized in this block
  break
}
print defined?(i0), "\n"       # "i0 was initialized in this block
print defined?(i1), "\n"       # nil; "i1" was initialized in the loop
```

Instance Variables

- A variable whose name begins with '@'
  - *@foobar*
- An instance variable belongs to the object itself.
- It is visible only inside the instance methods (all of them)
- Uninitialized instance variables have a value of nil.

Class Variables

- A variable whose name begins with '@@'
  - > *@@foobar*
- When you set a class variable, you set it for the superclass and all of the subclasses.
- You can access class variables everywhere in the class; it is visible in the class methods and in the instance methods

Class Variables: Example

```
class Polygon
  @@sides = 10
  def self.sides
    @@sides
  end
end
class Triangle < Polygon
  @@sides = 3
end

# Class variables are shared in the class hierarchy
puts Triangle.sides # => 3
puts Polygon.sides # => 3
```

Global Variables

- A variable whose name begins with '$' has a global scope; meaning it can be accessed from anywhere within the program during runtime.
  - *$foobar*
- Global variables should be used sparingly.
  - They are dangerous because they can be written to from anywhere.
  - Overuse of globals can make isolating bugs difficult

Pre-defined Variables

- $0 Contains the name of the script being executed. May be assignable.
- $* Command line arguments given for the script
- $$ The process number of the Ruby running this script.
- $? The status of the last executed child process.
- $: Load path for scripts and binary modules by load or require.
- More...

http://en.wikibooks.org/wiki/Ruby_Programming/Syntax/Variables_and_Constants#Pre-defined_Variables

Methods

Method Definitions

- Methods are defined using the keyword *def* followed by the method name.
- By convention method names that consist of multiple words have each word separated by an underscore.

```
def output_something(value)
  puts value
end
```

Class Method vs. Instance Method

- A class can contain both class and instance methods
- Class method is defined with *self.method_name*

```
class MyClass
  def self.find_everybody
      find(:all)
  end
  def my_instance_method
  end
end
```

- Class method is invoked with a class

```
MyClass.find_everybody
```

How to Invoke Methods

- Methods are called using the following syntax:

  method_name(parameter1, parameter2,…)
- If the method has no parameters the parentheses can usually be omitted as in the following:

  method_name
- If you don't have code that needs to use method result immediately, Ruby allows to specify parameters omitting parentheses:

```
# You need to use parentheses if you want to work with the result immediately.
# eg. If a method returns an array and we want to reverse element order:
results = method_name(parameter1, parameter2).reverse
```

Return Values

- Methods return the value of the last statement executed. The following code returns the value x+y.

```
def calculate_value(x,y)
  x + y
end
```

- An explicit return statement can also be used to return from function with a value, prior to the end of the function declaration. This is useful when you want to terminate a loop or return from a function as the result of a conditional expression.

Methods:
Arguments

Default Value Argument

- A default parameter value can be specified during method definition to replace the value of a parameter if it is not passed into the method or the parameter's value is nil.

```
def some_method(value='default', arr=[ ])
  puts value
  puts arr.length
end
some_method('something')
```

- The method call above will output:

```
something
0
```

Variable Length Argument List

- The last parameter of a method may be preceded by an asterisk(*), which is sometimes called the 'splat' operator. This indicates that more parameters may be passed to the function. Those parameters are collected up and an array is created.

```
def calculate_value(x,y,*otherValues)
  puts otherValues
end

calculate_value(1,2,'a','b','c')
```

- In the example above the output would be *['a', 'b', 'c']*.

Array Argument

- The asterisk operator may also precede an Array argument in a method call. In this case the Array will be expanded and the values passed in as if they were separated by commas.

```
arr = ['a','b','c']
calculate_value(*arr)
```

- has the same result as:

```
calculate_value('a','b','c')
```

Hash Argument

- Another technique that Ruby allows is to pass a Hash argument when invoking a function, and that gives you best of all worlds: named parameters, and variable argument length.

```
def accepts_hash( var )
  print "got: ", var.inspect     # will print out what it received
end

# Pass a hash as an argument
accepts_hash( {:arg1 => 'giving arg1', :argN => 'giving argN'} )
# => got: {:argN=>"giving argN", :arg1=>"giving arg1"}
```

Parentheses ( ) for the Arguments, Braces { } for a Hash Argument

- Parentheses can be omitted for the arguments
- If the last argument is a Hash, braces { } of the Hash can be omitted. The following three work the same.

```
# Arguments are with enclosed ( ), hash is enclosed with braces { }
accepts_hash( { :arg1 => 'giving arg1', :argN => 'giving argN' } )

# Argument are enclosed in parens, no { } for a hash
accepts_hash( :arg1 => 'giving arg1', :argN => 'giving argN' )

# No parentheses for arguments, no { } for a hash
accepts_hash :arg1 => 'giving arg1', :argN => 'giving argN'
```

Calling a Method with a Code Block

- If you are going to pass a code block to function, you need parentheses for arguments.

```
# You need parentheses for arguments since there is a block
accepts_hash( :arg1 => 'giving arg1', :argN => 'giving argN' )  { |s|
    puts s }
accepts_hash( { :arg1 => 'giving arg1', :argN => 'giving argN' } )  {
    |s| puts s }

# Compile error
accepts_hash :arg1 => 'giving arg1', :argN => 'giving argN'  { |s|
    puts s }
```

Methods:
Visibility

Declaring Visibility

- By default, all methods in Ruby classes are public - accessible by anyone.
- If desired, this access can be restricted by *private, protected* object methods.
  - It is interesting that these are not actually keywords, but actual methods that operate on the class, dynamically altering the visibility of the methods.

Visibility: private & protected

- If *private* is invoked without arguments, it sets access to private for all subsequent methods.
- The *private* methods can be called only from within the same instance
- The *protected* can be called both in the same instance and by other instances of the same class and its subclasses

```
class Example
  def methodA
  end
  private # all methods that follow will be made private:
          # not accessible for outside object
  def methodP
  end
end
```

Declaring Visibility: private

- *private* method can be invoked with named arguments - altering the visibility of methodP to private in the example below

```
class Example
  def methodA
  end

  def methodP
  end

  private :methodP # change the visibility of methodP to private
end
```

Methods:
Method with ! (Bang)

Method with ! (Bang)

- In Ruby, methods that end with an exclamation mark (also called a "bang") modify the object. For example, the method *upcase!* changes the letters of a String to uppercase.

```
>> comedian = "Stephen Colbert"
=> "Stephen Colbert"
>> comedian.upcase!
=> "STEPHEN COLBERT"
```

- Methods that do not end in an exclamation point return data, but do not modify the object.

Modules

What is a Module?

- Modules are way of grouping together some functions and variables and classes, thus providing namespaces.
- You can have methods and
- You can't instantiate a Module.

Mix-in

- You can include the module into a class - Mix-in

```
module MixAlot
  def say_what?
    "hello"
  end
end

class MC
  include MixAlot

  # ... method say_what? is available here!
end
```

Requiring a Module

- If your module is in another file, you must first *require* that module, to bring it in, before you can use it in include

Reserved Words (Key words)

Reserved Words

- =begin =end alias and begin BEGIN
- break case class def defined? do
- else elsif END end ensure false
- for if in module next nil
- not or redo rescue retry return
- self super then true undef unless
- until when while yield

Regular Expression

Regular Expression

- Lets you specify a pattern for match
- Use */pattern/* or *%r{pattern}*
- Simple pattern examples

```
/ruby|rails/        # match either ruby or rails
/r(uby|ails)/       # same as above
/ab+c/              # match a string containing an a followed one
                    # or more b followed by c
/ab*c/              # same as above except zero or more b
```

Regular Expression Usage in Ruby

- Usage in Ruby - "=~" is a matching operator with respect to regular expressions; it returns the position in a string where a match was found, or nil if the pattern did not match.

```
if subject =~ /r(uby|ails)/
    puts “subject matches the pattern”
end
```

Basic Patterns

- . (dot) - matches any single character
  - a.c matches "abc"
  - .at matches any three-character string ending with "at", including "hat", "cat", and "bat"
- [ ] - Matches a single character that is contained within the brackets
  - [abc] matches "a", "b", or "c"
  - [a-z] specifies a range which matches any lowercase letter from "a" to "z".
  - [abcx-z] matches "a", "b", "c", "x", "y", and "z", as does [a-cx-z].
  - [hc]at matches "hat" and "cat"

Basic Patterns

- [^] - Matches a single character that is not contained within the brackets
  - [^abc] matches any character other than "a", "b", or "c".
  - [^a-z] matches any single character that is not a lowercase letter from "a" to "z".
  - [^b]at matches all strings matched by .at except "bat".
- ^ - Matches the starting position within the string.
  - ^[hc]at matches "hat" and "cat", but only at the beginning of the string or line.
- $ - Matches the ending position of the string or the position just before a string-ending newline
  - [hc]at$ matches "hat" and "cat", but only at the end of the string or line.

Character Abbreviation

```
/fo\w+.*bar/          # “foobar”, “fogTS!bar, ...
%r[fo\w+.*bar]        # Same as above
```

Abbreviation	As [...]	Matches	Opposite
\d	[0-9]	Digit character	\D
\s		Whitespace character	\S
\w	[A-Za-z0-9_]	Word character	\W
.		Any character	

Sequence	Matches
*	**zero or more** occurrences of preceding character
+	**one or more** occurrences of preceding character
?	**zero or one** occurences of preceding character

Control Structures

Control Structure: Assignment

```
puts "----Every assignment returns the assigned value"
puts a = 4       #=> 4

puts "----Assignments can be chained"
puts a = b = 4   #=> 4
puts a+b         #=> 8

puts "----Shortcuts"
puts a += 2      #=> 6
puts a = a + 2   #=> 8

puts "----Parallel assignment"
a, b = b, a
puts a           #=> 4
puts b           #=> 8

puts "----Array splitting"
array = [1,2]
a, b = *array
puts a           #=> 1
puts b           #=> 2
```

Control Structure: Conditionals

```
puts "----if/else condition"
if (1 + 1 == 2)
  puts "One plus one is two"
else
  puts "Not a chance!"
end

puts "----if and unless conditions"
puts "Life is good!" if (1 + 1 == 2)
puts "Surprising" unless (1 + 1 == 2)

puts "----? condition"
puts (1 + 1 == 2)?'True':'Not True'

puts "----case/when/then condition"
spam_probability = rand(100)
puts "spam_probability = " + spam_probability.to_s
```

Control Structure: Conditionals

```
case spam_probability
when 0...10 then puts "Lowest probability"
when 10...50 then puts "Low probability"
when 50...90 then puts "High Probability"
when 90...100 then puts "Highest probability"
end
```

Control Structure: Loop

```
puts "---- while loop"
while (i < 10)
  i *= 2
end
puts i          #=> 16

puts "---- while loop 2"
i *= 2 while (i < 100)
puts i          #=> 128

puts "---- while loop with begin/end"
begin
  i *= 2
end while (i < 100)
puts i          #=> 256
```

Control Structure: Loop

```
puts "---- until"
i *= 2 until ( i >= 1000)
puts i        #=> 1024

puts "---- loop"
loop do
  break i if (i >= 4000)
  i *= 2
end
puts i        #=> 4096

puts "---- times"
4.times do
   i *= 2
end
puts i        #=> 65536
```

Control Structure: Loop

```
puts "---- array"
r =[]
for i in 0..7
  next if i % 2 == 0
  r << i
end
puts r

puts "----Many things are easier with blocks"
puts (0..7).select { |i| i % 2 != 0}
```

Exception Handling

Exception Class

- Exceptions are implemented as classes (objects), all of whom are descendents of the Exception class.
- List of Exceptions'
  - ArgumentError, IndexError, Interrupt
  - LoadError, NameError, NoMemoryError
  - NoMethodError, NotImplementedError
  - RangeError, RuntimeError
  - ScriptError, SecurityError, SignalException
  - StandardError, SyntaxError
  - SystemCallError, SystemExit, TypeError

Exception Handling

```
begin
    # attempt code here
rescue SyntaxError => mySyntaxError
    print "Unknown syntax error. ", mySyntaxError, "\n"
    # error handling specific to problem here
rescue StandardError => myStandardError
    print "Unknown general error. ", myStandardError, "\n"
    # error handling specific to problem here
else
    # code that runs ONLY if no error goes here
ensure
    # code that cleans up after a problem and its error handling goes here
end
```

Ruby Operators

Ruby Operators

- *a* || *b*
  - This expression evaluates *a* first. If it is not false or nil, then evaluation stops and the expression returns a. Otherwise, it returns b.
  - Common practice of returning a default value b if the first value has not been set
- *a* ||= *b*
  - Same as *a* = *a* || *b*

Ruby Basics