

# Ruby: Introduction, Basics

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## Lecture 5

# Ruby vs Java: Similarities

- Imperative and object-oriented
  - Classes and instances (ie objects)
  - Inheritance
- Strongly typed
  - Classes determine valid operations
- Some familiar operators
  - Arithmetic, bitwise, comparison, logical
- Some familiar keywords
  - `if, then, else, while, for, class, new...`

# But Ruby Looks Different

- Punctuation
  - Omits ;'s and often ()'s on function calls
  - Includes function names ending in ? and !
- New keywords and operators
  - **def, do..end, yield, unless**
  - **\*\* (exp), =~ (match), <=> (spaceship)**
- Rich core libraries
  - Collections: Hashes, Arrays
  - Strings and regular expressions
  - Enumerators for iteration

# Deeper Differences As Well

- Interpreted (typically)
  - Run a program directly, without compiling
- Dynamically typed
  - Objects have types, variables don't
- Everything is an object
  - C.f. primitives in Java
- *Code* can be passed in to a function as a parameter
  - Added to Java in version 8 (“lambdas”)

# Compiling Programs

- Program = Text file
  - Contains easy-to-understand statements like “print”, “if”, “while”, *etc.*
- But a computer can only execute *machine instructions*
  - Instruction set architecture of the CPU
- A *compiler* translates the program (source code) into an executable (machine code)
  - Recall “Bugs World” from CSE 2231
- Examples: C, C++, Objective-C, Ada...

# Interpreting Programs

- An interpreter reads a program and executes it *directly*
- Advantages
  - Platform independence
  - Read-eval-print loop (aka REPL)
  - Reflection
- Disadvantages
  - Speed
  - Later error detection (*i.e.*, at run time)
- Examples: JavaScript, Python, Ruby

# Combination of Both

- A language is not *inherently* compiled or interpreted
  - A property of its implementation
- Sometimes a combination is used:
  - Compile source code into an intermediate representation (byte code)
  - Interpret the byte code
- Examples of combination: Java, C#

# Ruby is (Usually) Interpreted

- REPL with Ruby interpreter, irb

```
$ irb
```

```
>> 3 + 4
```

```
=> 7
```

```
>> puts "hello world"
```

```
hello world
```

```
=> nil
```

```
>> def square(x) x**2 end
```

```
=> :square
```

```
>> square -4
```

```
=> 16
```



# Literals

## □ Numbers (Integer, Float, Rational, Complex)

83, 0123, 0x53, 0b1010011, 0b101\_0011

123.45, 1.2345e2, 12345E-2

2/3r, 4+3i

## □ Strings

■ Delimiters " " and ' '

■ Interpolation of `#{...}` occurs (only) inside " "

"Sum 6+3 is `#{6+3}`" is "Sum 6+3 is 9"

■ Custom delimiter with `%Q?...?` or `%q?...?`

## □ Ranges

■ 0..4 includes start *and* end value (ie 0, 1, 2, 3, 4)

■ "cab"... "cat" *does not* include end value

## □ Arrays and hashes (later)

# Comments and Statements

- Single-line comments start with #
  - Don't confuse it with string interpolation!
- Multi-line comments bracketed by  
=begin  
=end
  - Must appear at beginning of line
- All statements have a value result
- Convention: => to indicate result  

```
"Hi #{name}" + "!" #=> "Hi Liam!"
```

# Operators

- Arithmetic: + - \* / % \*\*
    - / is either ÷ or div, depending on operands
    - Integer / (div) rounds towards  $-\infty$ , not 0
    - % is modulus, not remainder
- 1 / 3.0 #=> 0.33333333333333333333
- 1 / 3 #=> 0 (*same as Java*)
- 1 / 3 #=> -1 (*not 0, differs from Java*)
- 1 % 3 #=> 2 (*not -1, differs from Java*)- Bitwise: ~ | & ^ << >>
  - 5 | 2 #=> 7 (*ie 0b101 | 0b10*)
  - 13 ^ 6 #=> 11 (*ie 0b1101 ^ 0b0110*)
  - 5 << 2 #=> 20 (*ie 0b101 << 2*)

# Operators (Continued)

- Comparison: `<` `>` `<=` `>=` `<=>`
  - Last is so-called “spaceship operator”
  - Returns -1/0/1 iff LHS is smaller/equal/larger than RHS

`"cab" <=> "da" #=> -1`

`"cab" <=> "ba" #=> 1`
- Logical: `&&` `||` `!` `and` `or` `not`
  - Words have low precedence (below =)
  - “do\_this or do\_that” idiom needs low-binding

`x = crazy or raise "problem"`

# Pseudo Variables

- Objects
  - **self**, the receiver of the current method (recall “this” keyword in Java)
  - **nil**, nothingness (recall null)
- Booleans
  - **true**, **false**
  - nil also evaluates to false
  - 0 is *not* false, it is true just like 1 or -4!
- Specials
  - **\_\_FILE\_\_**, the current source file name
  - **\_\_LINE\_\_**, the current line number

# Significance in Names

- A variable's *name* affects semantics!
- Variable name determines its scope
  - Local: start with lowercase letter (or `_`)
  - Global: start with `$`
    - Many pre-defined global variables exist, *e.g.*:
      - `$/` is the input record separator (newline)
      - `;$` is the default field separator (space)
  - Instance: start with `@`
  - Class: start with `@@`
- Variable name determines mutability
  - Constant: start with uppercase (`Size`)  
but idiom is all upper case (`SIZE`)

# Basic Statements: Conditionals

- Classic structure

```
if (boolean_condition) [then]
    ...
else
    ...
end
```

- But usually omit ( )'s and "then" keyword

```
if x < 10
    puts "small"
end
```

- "if" keyword is also a *statement modifier*

```
x = x + 1 if x < LIMIT
```

- Good for single-line body
- Good when statement execution is common case
- Good for positive conditions

# Variations on Conditionals

- Unless: equivalent to “if not...”

```
unless size >= 100
  puts "small"
end
```

- Do not use “else” with “unless”
- Do not use negative condition (“unless !...”)

- Can also be a statement modifier

```
x = x + 1 unless x >= LIMIT
```

- Good for: single-line body, positive condition
- Used for: Guard clause at start of method  

```
raise "unpaid" unless invoice.pending?
```



# Pitfalls with Conditionals

- Keyword "elsif" instead of "else if"

```
if x < 10
  puts "small"
elsif x < 20
  puts "medium"
else
  puts "large"
end
```

- If's *do not* create nested lexical scope

```
if x < 10
  y = x
end
puts y # y is defined, but could be nil
puts z # NameError: undefined local var z
```

# Case Statements are General

```
[variable = ] case expression
```

```
when nil
```

```
    statements execute if the expr was nil
```

```
when value # e.g. 0, 'start'
```

```
    statements execute if expr equals value
```

```
when type # e.g. String
```

```
    statements execute if expr resulted in Type
```

```
when /regexp/ # e.g. /[aeiou]/
```

```
    statements execute if expr matches regexp
```

```
when min..max
```

```
    statements execute if the expr is in range
```

```
else
```

```
    statements
```

```
end
```

# Basic Iteration: While and Until

## □ Classic structure

```
while boolean_condition [do]
```

```
...
```

```
end
```

- Can also be used as a statement modifier

```
work while awake
```

## □ Until: equivalent to "while not..."

```
until i > count
```

```
...
```

```
end
```

- Can also be used as a statement modifier

## □ Pitfall: Modified *block* executes at least once

```
sleep while dark # may not sleep at all
```

```
begin i = i + 1 end while i < MAX
```

```
  # always increments i at least once
```

# Functions

- Definition: keyword `def`

```
def foo(x, y)
    return x + y
end
```

- Notice: no types in signature

- No types for parameters
- No type for return value

- All functions return *something*

- Value of last statement implicitly returned
- Convention: Omit explicit return statement

```
def foo(x, y)
    x + y # last statement executed
end
```

# Function Calls

- Dot notation for method call

```
Math::PI.rationalize() # recvr Math::PI
```

- Convention: Omit ( )'s in definition of functions with no parameters

```
def launch() ... end # bad  
def launch ... end # good
```

- Paren's can be omitted in calls too!

```
Math::PI.rationalize  
puts "hello world"
```

- Convention: Omit for "keyword-like" calls

```
attr_reader :name, :age
```

- Note: needed when chaining

```
foo(13).equal? value
```



# Summary

- Ruby is a general-purpose, imperative, object-oriented language
- Ruby is (usually) interpreted
  - REPL
- Familiar flow-of-control and syntax
  - Some new constructs (e.g., unless, until)
  - Terse (e.g., optional parentheses, optional semicolons, statement modifiers)