20CYS312 - Principles of Programming Languages
Exploring Programming Paradigms

Assignment-01

Presented by Anuvarshini M K
CB.EN.U4CYS21008
TIFAC-CORE in Cyber Security
Amrita Vishwa Vidyapeetham, Coimbatore Campus

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AMRITA
VISHWA VIDYAPEETHAM

Outline

Scripting

- Scripting refers to the creation and execution of scripts written in Scripting language
- Scripting languages are programming languages that are mostly interpreter-based
- This means that at runtime, the scripts are directly interpreted by the environment to get the result instead of being translated to machine understandable code before being run.
- The interpreter executes the program directly, translating each statement into a sequence of one or more subroutines, and then into machine code.
- Coding in a scripting language involves few lines of code that can be used within large programs.

Scripting - Python

Scripting in Python means , writing a python program with multiple python commands and save it in a single file (.py). In contrast to Interactive mode , where we login to python shell and run commands one by one. Key features of python scripting are:

- High level - The code structure is far away from machine language and can be easily understood by humans
- Portable - a python script created for a certain task need not to be modified according the OS , it automatically adapts to the environment when it is being run on a different OS
- Extensible - Python can be easily integrated with other programming language, such as importing org.python.util.PythonInterpreter in java helps to use python modules in java
- Python supports various programming paradigms like imperative and declarative programming, functional programming, and object-oriented programming etc.
- Large standard library

Code snippet

```
myList = [1, 2, 3, 4, 5]
total = sum(x**2 for x in myList if x % 2 == 1)
print(total)
```

Figure: python script - 1

```
import os
files = os.listdir()
for file in files:
    print(file)
```

Figure: python script - 2

Applications

Python scripting is used everywhere in industries where it needs Web development , Automation , Data science , Machine learning and AI etc.

Here are some python modules which helps in real life tasks:

- Data Analysis with Pandas
- Web Scraping with BeautifulSoup
- Automated Email Sender with smtplib
- Data Backup using shutil
- PDF Generator with ReportLab

Here are some examples of python used in real world application:

- Python is primarily used at Spotify to serve Backend services and Data analysis.
- Python-based apps are used by Netflix to manage the majority of their network devices.
- Dropbox uses Python because of its cross-platform support, better readability a Ease of learning.

Meta - Programming

- Meta-Programming is a programming technique which treats other program as data
- It means that a program can be designed to read, generate, analyze or transform other programs, and even modify itself during program execution
- In some cases, this allows programmers to minimize the number of lines of code to express a solution, in turn reducing development time by DRYing up the code.

Meta-Programming in Ruby

- In Ruby, Meta-Programming refers to code that writes code for you but dynamically (during and after runtime) as opposed to statically (before runtime).
- It allows us to define/redefine methods and classes during run time in Ruby spontaneously instead of having to define them in the program itself.
- Key features of Meta-Programming in Ruby:
  - Dynamic Code Generation - allows creating classes, methods, or modifying existing ones on the fly.
  - DSL creation - making code more readable and expressive for domain-specific tasks.

Code snippet

Monkey Patching - Ruby gives you the ability to re-open any class and enhance, change or override its methods. This includes any built-in class in the Ruby language including String, Integer, Array, or Hash. This ability is referred to as Monkey Patching.

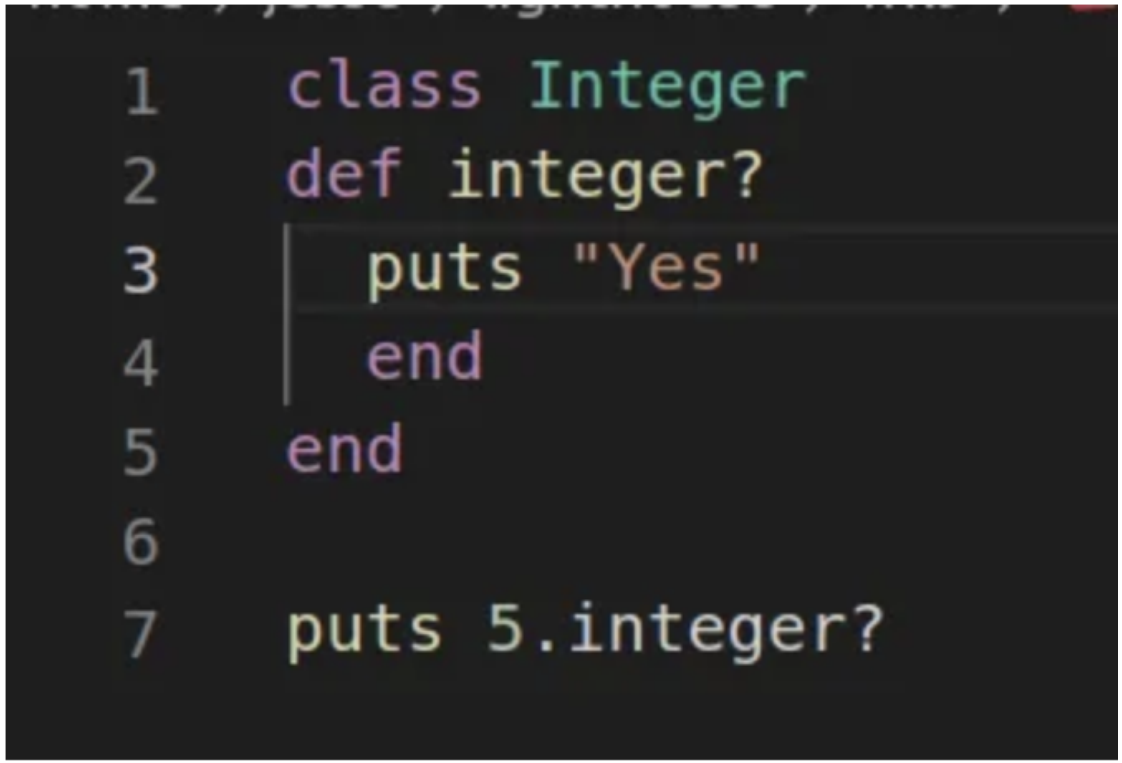

Figure: open class

Code Snippet - cont.

An example of few methods in ruby which supports meta-programming to create methods during run time.

```ruby
class MyClass
    def existing_method
      puts "This is an existing method."
    end
  end
obj = MyClass.new
obj.existing_method
MyClass.class_eval do
    define_method(:class_dynamic_method) do
      puts "This class method is added on the fly using class_eval and define_method."
    end
  end
 obj.instance_eval do
    define_method(:dynamic_method) do
      puts "This instance method is added on the fly using instance_eval and define_method."
    end
  end
MyClass.class_dynamic_method
obj.send(:dynamic_method)
```

Figure: open class

Applications

Ruby on Rails, often referred to as Rails, is a web application framework written in the Ruby programming language. where the model component handles all database communications and business logic (information exchanged between the database and website interface)

Ruby on Rails framework has lot of plugin and extensions which makes building websites like these simple:

- eCommerce platforms such as Shopify
- Content Management Systems (CMS) such as Github pages
- Social Networking Apps such as twitter

Comparison between Scripting-Python and Meta-Programming-Ruby

SIMILARITIES

- Interpreted execution: Both Python scripting and Ruby meta-programming occur at runtime , hence both are scripting language
- High-level: Both languages prioritize clear and concise syntax. Python is renowned for its natural language-like readability, while Ruby offers expressive shortcuts and code blocks that can make meta-programming code more compact.
- Degree of meta-programming: Both python and ruby can implement meta programming however , ruby has more meta programming features than python
- OOPS: Both support object oriented programming

Comparison between Scripting-Python and Meta-Programming-Ruby(cont.)

DIFFERENCES

- **Primary purpose**
  Python scripting: Automating tasks
  Ruby Meta-programming: Dynamically modifying code at runtime
- **Syntax focus**
  Python scripting: Data and operations
  Ruby Meta-programming: Code structure and manipulation
- **Flexibility**
  Python scripting:Somewhat less flexible
  Ruby Meta-programming:Highly flexible due to meta-programming features
- **Readablity**
  Python scripting: Generally considered more readable
  Ruby Meta-programming: Can be less readable if overused
- **Common Uses**
  Python scripting: Data analysis, web development, automation
  Ruby Meta-programming: DSL creation, framework development, dynamic code

References

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