Approaching Towards Computational Thinking with R and Python (ACTRP)

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Approaching Towards Computational Thinking with R and Python

The Training Course in Python and R language is designed to give you a foundation in learning Computation in main stream research and data analysis from a science background.
We all know R and Python both are very versatile, powerful and flexible Open Source languages, which are used for data analysis and data visualization. Both of these languages are widely used by business, academia, government and corporations around the world. We will mostly be focused on different academia uses of these two powerful tools.
We are going to show how you can do (literally) anything with these two languages – starting from basic maths to analysing Astronomical data.

The core philosophy of this course will be to understand how to use programming languages in scientific world.

It should be noted that this will be a course totally different from conventional programming courses as It will be highly tilted towards the application of any language towards science community specially towards Maths and Physics.
You don't have to be a programmer to do programming as programming relies on logical thinking and we are just going to do that.

Course Overview

In this course we will learn,
Python:

1. Installation and setting up the environment, basic python programming, i.e., data types, predefined functions, Basic Maths operations, Math library.
2. Idea of if-else statement, lists, tuple and for & while loops.
3. A brief discussion on modular arithmetic (math theory discussion), Definition of Functions.
4. Properties of primes and implementation in python and many more examples.
5. Introduction to Numpy and Matplotlib and its application. (Linear Algebra and Calculus).
6. Numerical Methods (Bisection Method, Newton Raphson), Numerical differentiation (Forward Divided Difference), Numerical Integrations (Trapizoidal Rule) and its implementation.
7. Introduction to Scipy and its application in calculus.
8. Learning numerical method for solving Differential Equations (Euler's and Runge-Kutta method) and introduction to Fourier Transformation using Scipy.
9. Introduction to pandas and curve fitting (real lab data analysis)
10. Introduction sympy and symbolics calculation using python.
11. Solving elementary quantum mechanics using python and qmsolver.
12. Introduction to Astronomy using Astropy.
13. Introduction to Quantum Computing with qiskit.

R:

1. Installation and setting up the environment, basic R programming (R as a calculator), i.e., data types, predefined functions, basic Maths operations.
2. Data Analysis using basic R.
3. Data cleaning, wrangling using {tidyverse} package.
4. Data visualisation using base R and using {ggplot2}.
5. Pre-college Mathematics, Matrix Algebra and Numerical Computations.
6. Introduction to Descriptive Statistics with R.

7. Introduction to Probability Theory, Probability Distribution, Sampling Distribution and Statistical Inference.
8. Basic Statistical Modelling (Linear Model, Regression and Classification).
9. Astronomical data analysis, model building and prediction.
10. Sports Analytics (Cricket and Football) with R.
11. Web Application: Create and publish your own app using R Shiny

Prerequisites

No prerequisites are needed for any of the languages. Although a bit of elementary knowledge will be very helpful for maths and physics (upto class 12th Physics and Mathematics of standard Indian syllabus).

Learning Outcomes

By the end of the course, you'll be confident and equipped with all the knowledge required to perform computational and analytical activities in both Python and R. Specially,

- **Understand** the fundamental syntax of R + Python through readings, practice exercise, demonstration and writing code.
- **Apply** critical programming language concepts such as data types, iterations, functions and boolean operators by writing both of the programs through exercises.
- **Analyse** a dataset in R/Python and get insights from it.
- **Intermediate understanding & implementation** of R/Python programming for Mathematical and statistical modelling, mathematical programming purpose.

Pedagogy for Course Delivery

The sessions will be taught using theory and practical methods. In addition to numerical applications, real-life problems and situations will be assigned to the learners and they are encouraged to get a feasible solution that could deliver meaningful and acceptable to the end users. The online course will be delivered using Zoom/ G-meet. Support material is supplied online usually via Google Drive.

Instructors

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