PYTHON FOR COMPUTATIONAL PROBLEM SOLVING

Introduction to Programming Languages

Prof. Sindhu R Pai
PCPS Theory Anchor – 2024
Department of Computer Science and Engineering

Programming

- Giving **instructions to a computer** to perform specific tasks
- **Translates human logic** to a form computers can understand

Programming Languages (PLs)

- **Tools used to write programs** that computers can execute
- Instructions communicated effectively. Thanks to **syntax (set of rules) provided by PLs**
- **Why:** Computers only understand binary (0s and 1s). PLs act as a bridge between humans and computers
- **Eg:** Python, C, C++, JavaScript, Golang, R etc.

Why so many programming languages?

- **Different Needs:** Each language is **designed to solve specific types of problems** or target different applications (e.g., web development, system programming, data analysis)

- **Evolving Technology:** As technology changes, **new languages emerge** to meet modern requirements, offer better performance, or provide new features.

- **Efficiency and Flexibility:** Some languages are **better suited for certain tasks**. For example, Python is great for rapid development, while C is ideal for performance-critical systems.

The TIOBE Index

- Measure of popularity of programming languages, updated once a month
- Uses online search engine results to track language trends over time
- Not about which programming language is “the best”

https://www.tiobe.com/tiobe-index/

PYTHON FOR COMPUTATIONAL PROBLEM SOLVING

Introduction to Programming Languages

PES UNIVERSITY
CELEBRATING 50 YEARS

The TIOBE Index (as of September 2024)

Sep 2024	Sep 2023	Change	Programming Language	Ratings	Change
1	1		Python	20.17%	+6.01%
2	3	↑	C++	10.75%	+0.09%
3	4	↑	Java	9.45%	-0.04%
4	2	↓	C	8.89%	-2.38%
5	5		C#	6.08%	-1.22%
6	6		JavaScript	3.92%	+0.62%
7	7		Visual Basic	2.70%	+0.48%
8	12	⇈	Go	2.35%	+1.16%
9	10	↑	SQL	1.94%	+0.50%
10	11	↑	Fortran	1.78%	+0.49%

Types of Programming Languages

- **Low Level:** Directly understood by machine. Much harder to code with, but has the fastest performance.
Eg: Machine language

- **Middle Level:** Provides some basic data structures and definitions while still maintaining direct interaction with the machine. Still somewhat hard to code with, but has fast performance.
Eg: C, C++

- **High Level:** Focuses on ease of use and provides many programming structures by default. Worse performance but very easy to code and develop with.
Eg: Python, JavaScript

PES UNIVERSITY
CELEBRATING 50 YEARS

Python: An Introduction

- First published in Feb 1991 by Guido van Rossum
- **Multi–paradigm** programming language
- Highly **simple and readable**
- As of Sept 2024, Python Package Index contains **more than 565,000 packages**
- **Versatile uses:** GUIs, test frameworks, automation and web scraping, scientific computing, text processing, image processing, graph generation etc.
- **Extremely popular:** used for YouTube, Dropbox, Spotify, Instagram, Pinterest, Uber, Reddit etc.

Applications of Python

- **Data Science:** Libraries like NumPy, Pandas, Matplotlib etc. are used for predictive analysis, data processing and data visualisation
- **AI & Machine Learning:** Python is used to develop neural networks and NLP systems using libraries like Tensorflow and Pytorch
- **Web Development:** Frameworks like Django and Flask power large scale web applications like Instagram
- **Drug Discovery:** Python is used in molecular modelling and simulations using libraries like Open Babel and PyMOL

Applications of Python

- **IoT and Embedded Systems:** Integrations with platforms like Raspberry Pi and Arduino to control hardware devices
- **Circuit Design and Simulation:** Tools like PySpice, SKiDL are used for circuit simulation and PCB design
- **Computational Fluid Dynamics (CFD):** Libraries such as OpenFOAM are used for simulating fluid flow
- **Structural Analysis:** Frameworks like OpenSeesPy are used for structural modelling and earthquake engineering

THANK YOU

Department of Computer Science and Engineering

Dr. Shyalaja S S, Director, CCBD and CDSAML, PESU
Prof. Sindhu R Pai – sindhurpai@pes.edu

Ack: Teaching Assistant – Advaith Sanil Kumar