Python & Biopython for Biologists

From Zero Programming to Structural Bioinformatics & Molecular Docking

Program Overview

This intensive program is designed for biologists who want to leverage Python for real-world bioinformatics applications. Starting with absolute basics, the course gradually advances into sequence analysis, structural biology, network analysis, and molecular docking.

Who Is This For?

- Life science students with no coding background
- Researchers working with sequence or structural data
- Aspiring bioinformaticians
- Anyone interested in computational biology using Python

What You Will Learn

Module - I : Fundamentals of Python

1. Python Foundations for Biology

Build a strong programming base using biological examples.
Learn how to store, manipulate, and process DNA, RNA, and protein data using Python.

2. Sequence Manipulation & String Processing

Work directly with biological sequences using Python string operations.
Perform GC content analysis, sequence transformations, and pattern detection.

3. Data Structures for Biological Data

Organize biological datasets using lists, tuples, and dictionaries.
Model real biological systems such as codon tables and amino acid properties.

4. Logical Thinking & Automation

Write efficient code using loops and conditional logic.
Automate repetitive biological analyses and filtering tasks.

5. Functions & Reusable Bioinformatics Code

Build reusable tools for sequence analysis such as GC calculation and translation.
Write modular and well-documented code.

6. File Handling & Scientific Computing
Work with FASTA files and biological datasets.
Use NumPy for numerical analysis and Matplotlib for visualization.

Module - II : Biopython & Core Bioinformatics Workflows

7. Biopython for Sequence Analysis
Use Biopython to manipulate DNA, RNA, and protein sequences.
Perform transcription, translation, and sequence transformations.

8. Working with Biological File Formats
Read and write FASTA and GenBank files.
Extract annotations and biological features programmatically.

9. NCBI Database Integration
Fetch sequences and biological records directly from NCBI databases.
Automate retrieval of genomic and literature data.

10. BLAST & Homology Analysis
Perform sequence similarity searches using BLAST.
Parse results and identify homologous sequences.

11. Multiple Sequence Alignment & Phylogenetics
Align sequences and construct phylogenetic trees.
Understand evolutionary relationships and sequence conservation.

12. Motif Analysis & Restriction Enzymes
Identify sequence motifs and restriction enzyme sites.
Analyze biological patterns within DNA sequences.

13. Structural Bioinformatics (PDB Analysis)
Parse protein structures and extract atomic and residue-level information.
Analyze structural properties such as B-factors and hydrophobicity.

Module - III : Advanced Applications in Bioinformatics

14. Structural Comparison & RMSD Analysis
Compare protein structures using superimposition techniques.
Understand structural similarity through RMSD metrics.

15. Network Biology & Sequence Similarity Networks
Convert BLAST results into network graphs.
Visualize relationships between proteins using interactive tools.

16. Molecular Docking & Drug Discovery

Understand the fundamentals of molecular docking.
Prepare proteins and ligands, run docking simulations, and interpret results.

17. Data Analysis with Pandas
Work with structured biological datasets.
Filter, group, and analyze protein and sequence data efficiently.

18. Dimensionality Reduction & Clustering
Apply PCA and clustering techniques to biological datasets.
Identify patterns and group similar biological entities.

19. Pipeline Automation & Workflow Design
Build end-to-end bioinformatics pipelines.
Automate data retrieval, analysis, and visualization steps.

Capstone Project

Bring everything together by performing a complete structural and sequence analysis of a target protein. Integrate sequence retrieval, BLAST analysis, structural parsing, and visualization into a single workflow.

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