Practical Approaches in Computational Biology and Bioinformatics

Course Code: JAL 302
Credits: 3-1-0

Instructor: Dr. Divyashri Baraniya

Basic requirements for attending this course are:

- Understanding of basic molecular biology, biological sequences, biological databases and basic algorithms used for sequence alignments and phylogenetics.
- Familiarity with Shell scripting (Linux) and "R" for statistical and graphical analysis.

Course content

1. **Structural Bioinformatics**
   - Characteristics of peptides, amino acids, architecture and contents of genomes.
   - Public repositories of structural data
   - Protein structure analysis and prediction
   - Structure validation and assessment tools
   - Introduction to drug discovery: tools and resources
   - Practical + assignments

   Tutorial classes

2. **Genomics and epigenomics data analysis**
   - Denovo genome assembly.
   - Exome sequencing analysis.
   - Metagenomics: whole genome metagenomics and 16S rRNA and ITS based metagenome analysis.
   - Methylation profiling.
   - Variant analysis.
   - Functional location mapping.
   - Practical + assignments

   Tutorial classes

3. **Transcriptomic data analysis**
   - Differential gene expression (DEG) analysis.
   - Introduction to Gene Ontology (GO), Kyoto Encyclopedia of Genes and Genomes (KEGG) and STRING.
   - Pathway enrichment and analysis.
   - Practical + assignments

   Tutorial classes

4. **Introduction to Python programming**
    - Introduction to Python: Syntax, data types, file handling and modules.
    - Biopython : Handling sequences, sequence alignments and working with 3D structures.
    - Bioinformatics with Scikit-Bio: Handling sequences, working with different data formats and phylogenetics.
    - Practical + assignments

    Tutorial classes

References:

1. **Python for Bioinformatics** by Sebastian Bassi.
2. **Bioinformatics with Python cookbook** by Tiago Antao.
3. **Bioinformatics for Omics Data** by Bernd Mayer
4. **Structural Bioinformatics methods and protocols**, edited by Zoltàn Gàspàri.
5. **Transcriptomics: Expression pattern analysis** by Virendra Gomase and Somnath Tagore.