

# **Biological Datatypes & Databases**

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# Biological Data Types

- ❑ Biological data refers to a compound or information derived from living organisms and their products.
- ❑ Bioinformatics plays a pivotal role in managing and analyzing vast amounts of biological data generated through various experimental techniques.
- ❑ Bioinformatics tools enable researchers to extract meaningful patterns, identify relationships, and derive valuable knowledge from diverse biological datasets.
- ❑ Types of Biological Data Types:
  - ***Genomic Data***
  - ***Transcriptomic Data***
  - ***Proteomic Data***
  - ***Metabolite Data***
  - ***Epigenomic Data***
  - ***Microbiome Data***
  - ***Clinical and Phenotypic Data***
  - ***Structural Biology Data***
  - ***Data Integration and Systems Biology***

# Biological Data Types

- **Genomic Data:**

- 1) Consists of the raw DNA/nucleotide sequences (A, T, C, G) of an organism's genome.

- 2) Applications:

- Comparative Genomics: Comparing DNA sequences across different species for evolutionary insights

- Variant Calling: Detecting genetic variations (differences in DNA sequences) such as single nucleotide polymorphisms (SNPs) and insertions/deletions (indels)

- De Novo Assembly: Reconstructing entire genomes without a reference genome

- **Transcriptomic Data:**

- 1) Consists of sequences of RNA molecules transcribed from DNA, including mRNA, rRNA, tRNA, and non-coding RNAs.

- 2) Applications:

- Determine expression levels of genes

# Biological Data Types

- ***Proteomic Data:***

- 1) Consists of amino acid sequences encoded by genes
- 2) Applications:
  - Identifying and characterizing post-translational modifications on proteins
  - Constructing and analyzing protein interaction networks (Homology Modeling)
  - Predicting potential drug targets based on protein interactions (Drug Design)

- ***Metabolite Data:***

- 1) Information about the small molecules (metabolites) present in a biological sample.
- 2) Applications:
  - Predicting the distribution of metabolic fluxes through pathways.

# Biological Data Types

- ***Microbiome Data:***

- 1) DNA sequences of microorganisms in a given environment, often obtained through 16S rRNA sequencing or metagenomics.
- 2) Applications:
  - Estimating the richness and evenness of microbial communities and Comparing microbial compositions across different samples.

- ***Clinical and Phenotypic Data:***

- 1) Information about patients, including medical history, diagnoses, treatments, and outcomes.
- 2) Applications:
  - Precision medicine, clinical research, outcome prediction

- ***Structural Biology Data:***

- 1) 3D structures of macromolecules such as proteins, nucleic acids, and complexes.
- 2) Applications:
  - Structure and function prediction, drug design, evolutionary data

# Biological Databases

- ❑ A database is a systematic/organized collection of data (db).
- ❑ It is a collection of structured, searchable (index), updated periodically (release) and cross-referenced (hyperlinks) data.
- ❑ These databases simplify the management, handling and analysis process.
- ❑ Types of databases:

- a. Relational database:**

- Database relationships are organized in the form of tables. E.g., MySQL, ORACLE

- b. Object-oriented database:**

- Data stored in the form of objects. E.g., MongoDB offers OOD

- c. Biological database:**

- Store biological data like protein/DNA/RNA sequences, structures, binding sites, metabolic interactions in computer readable form.