

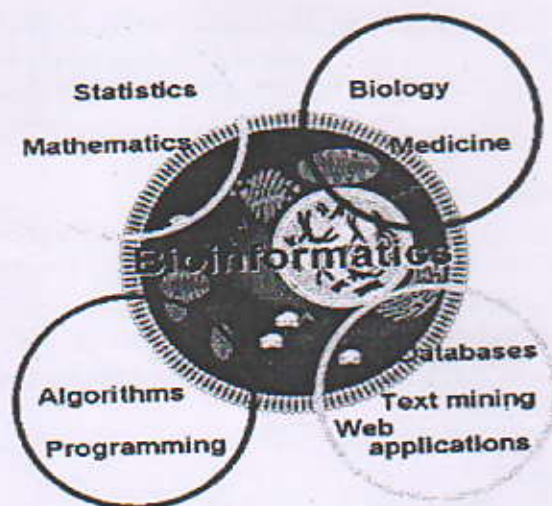
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CHAPTER

BIOINFORMATICS

INTRODUCTION

Science of collecting and organizing biological data is known as Bioinformatics. It is a branch of computer science that develops various methods and software tools to understand and analyze biological data.



Bioinformatics combines the use of mathematical, statistical and computational methods to analyze various types of biological, molecular and genetic data. It mainly helps in studying varied forms of DNA structures and compositions. Biochemists all over the world are trying to find out correlation between various DNA and are studying about every single cell in the body. They are trying to find answers to following questions –

- How DNA is formed and what is the exact composition of DNA?
- How does a protein bind to another protein?
- How DNA causes genetic disorders and how they can be prevented?

What is Bioinformatics?

- "The mathematical, statistical and computing methods that aim to solve biological problems using DNA and amino acid sequences and related information"



OBJECTIVES OF BIOINFORMATICS

Bioinformatics is necessary to understand the proper functioning of genes in human body because in later stages of pharmacy; a particular drug's design, target selection in a disease and its mode of action is entirely based on these facts. Thus, we can say that objectives of bioinformatics are as follows –

- Study normal biological processes
- Analyze the cause of disease due to malfunctioning of biological processes
- Design various approaches to improve biological processes
- Aids in improving drug discovery techniques
- Helps in developing new target drugs for fatal diseases.
- Enables study and research on development of preventive medicines for life-threatening diseases like cancer.

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Cellular &
Genetic Targets

Genomics

Proteomics

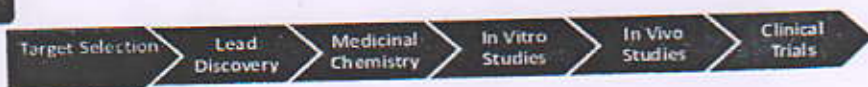
Bioinformatics

Bioinformatics:

Bioinformatics is a branch of molecular biology that involves extensive analysis of biological data using computers, for the purpose of enhancing biological research.

It plays a key role in various stages of the drug discovery process including

- > target identification
- > computer screening of chemical compounds and
- > pharmacogenomics



Hence, bioinformatics helps in analyzing data that is globally available and highlight the facts which are unique to all of them.

BIOINFORMATICS DATABASE

Bioinformatics database refers to collection and compilation of data which is structured, presented and cross referenced across the globe. Some of the bioinformatics databases are as follows:

- Genbank, Uniprot - Used in biological sequence analysis
- InterPro, Pfam - Used in finding Protein Families
- Sequence Read Archive- Used for Next Generation Sequencing
- GenoCAD - Used in design of synthetic genetic circuits
- PreDDICTA - Calculates drug DNA interaction
- Sanjeevani - Complete drug design software

Features of biological databases

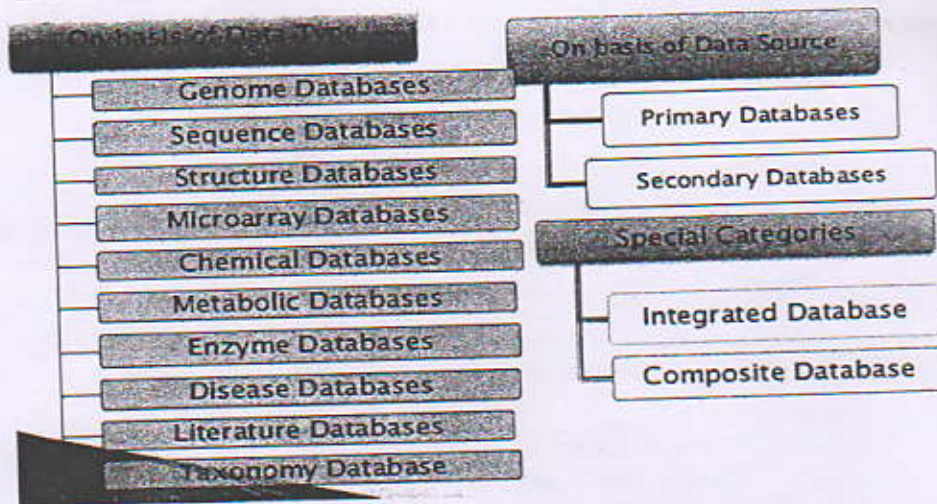
- 1) Data heterogeneity
- 2) High volume data
- 3) Uncertainty
- 4) Data Curation
- 5) Large scale data integration
- 6) Data sharing
- 7) Dynamic and subject to change

Classification of Bioinformatics Databases - They can be classified on the basis of -

- Data Type
- Data Source
- Database Design
- Special Categories

The different types of bioinformatics databases are listed below -

BRIEF CLASSIFICATION OF DATABASES



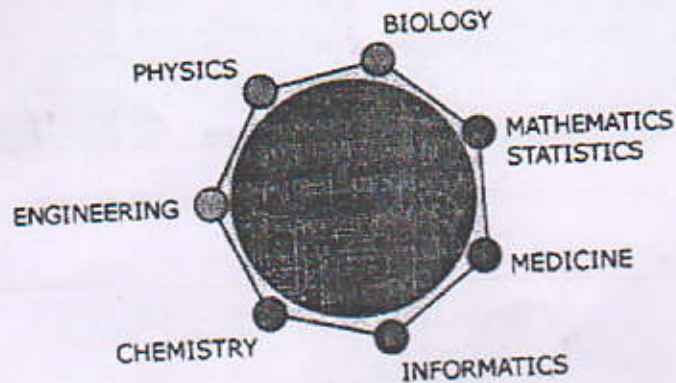
Biological Databases	
Types of Databases	Information
Bibliographic database	Literature
Taxonomic database	Classification
Nucleic acid database	DNA information
Genomic database	Gene information
Protein database	Protein information
Enzyme/Metabolic Pathway	Metabolic information

Bioinformatics Database is essential for research and development. It is used in many essential applications. Through bioinformatics, we can solve existing biological problems and can predict the new ones as well.

CONCEPT OF BIOINFORMATICS

Concept of Bioinformatics refers to its approach towards balancing biology, mathematics and computer programming in order to ensure availability of tools to compute and analyze biological data in a best possible manner. It provides a deeper understanding of molecular biology, software programs, program coding and decoding, genetic data analysis and study of DNA structure and composition.

Bioinformatics involves integration of computers, software tools, and databases that are used to address various biological queries. The two major activities involved in bioinformatics are study of genomics and proteomics where genomics refer to analysis of genomes (set of DNA sequence responsible for hereditary functions) and proteomics refer to study and analysis of complete set of proteins.



Bioinformatics is getting very popular because it applies knowledge from both Biology and Computer Science and this knowledge is further used to find new techniques of biological development for better human health and society. Bioinformatics provides a very challenging task for its researchers as it usually converts biological observations into a digital format or language that can be read by the computer. This technique of digitalizing each and every biological reaction or behavior into computer readable format is known as bioinformatics.

IMPACT OF BIOINFORMATICS IN VACCINE DISCOVERY

Bioinformatics help in discovery of vaccines in a more effective way and in shorter span of time. This is because it combines biology with pharmacology. Bioinformatics reduces the time and cost required to develop high potency drugs with fewer side effects.

Science of genomics plays a vital role in improving human health globally. It has been found that if a genome sequence of pathogen is available, a vaccine can be easily created to destroy that sequence and hence, occurrence of disease can be prevented. Genomic data are processed by a variety of software programs that help identify individual genes and their outcomes.

Designing an ideal vaccine largely depends on targeted pathogens and their interactions with existing drugs. Study of genome sequences of various pathogens along with rapid advancements in biotechnology allows us to collect large amount of useful information about hosts and pathogens that play an important role in discovery of vaccines.