Biyani's Think Tank

Concept based notes

Fundamentals of Bioinformatics and Nanotechnology

(B.Sc.Biotech Part-III)

Ms. Deepti Shungloo
Deptt. of Science
Biyani Girls College, Jaipur

Biyani's Group of Girls' Colleges

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Think Tanks
Biyani Group of Colleges

Sector-3, Vidhyadhar Nagar,
Jaipur-302 023 (Rajasthan)
Ph : 0141-2338371, 2338591-95 • Fax : 0141-2338007
E-mail : acad@biyanicolleges.org
Website :www.gurukpo.com; www.biyanicolleges.org

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Preface

I am glad to present this book, especially designed to serve the needs of the students. The book has been written keeping in mind the general weakness in understanding the fundamental concepts of the topics. The book is self-explanatory and adopts the "Teach Yourself" style. It is based on question-answer pattern. The language of book is quite easy and understandable based on scientific approach.

Any further improvement in the contents of the book by making corrections, omission and inclusion is keen to be achieved based on suggestions from the readers for which the author shall be obliged.

I acknowledge special thanks to Mr. Rajeev Biyani, *Chairman* & Dr. Sanjay Biyani, *Director* (*Acad.*) Biyani Group of Colleges, who are the backbones and main concept provider and also have been constant source of motivation throughout this Endeavour. They played an active role in coordinating the various stages of this Endeavour and spearheaded the publishing work.

I look forward to receiving valuable suggestions from professors of various educational institutions, other faculty members and students for improvement of the quality of the book. The reader may feel free to send in their comments and suggestions to the under mentioned address.

Author

Syllabus

B.Sc./M.Sc.

Fundamentals of Bioinformatics and Nanotechnology

Note : Question No. 1 shall consist of questions requiring short answers and shall cover entire paper. The paper is divided into four sections. Students are required to attempt five questions in all, selecting not more than one question from each section. All questions carry equal marks.

Section-A

1. Introduction to Bioinformatics
2. Aspects of Bioinformatics
3. Role of Bioinformatics in Biotechnology

4. Applications of Bioinformatics

Section-B

5. Introduction to Nanotechnology
6. Carbon Nanostructures
7. Properties of Nanoparticles

Section-C

8. Biological Materials in Nanotechnology
9. Nanomachines and Devices
10. Advanced Nanotechnology

Section-D

11. Medical Nanotechnology
12. Bio Nanotechnology
13. Nanotechnology and Society

FUNDAMENTALS OF BIOINFORMATICS AND NANOTECHNOLOGY

Q.1. What is Nanotechnology?

Ans. Nanotechnology is a multidisciplinary area of applied sciences and engineering that deals with the design and manufacture of extremely small components and systems.

Q.2. How did Nanotechnology evolve?

Ans. "Richard Feynman" a brilliant Nobel laureate physicist in a lecture on 29 December 1959 described the term Nanotechnology as "a process by which the ability to manipulate individual atoms & molecules might be developed, using one set of precise tools to build and operate another proportionally smaller set." He didn't use the term Nanotechnology. Nanotechnology reached greater public awareness in 1986 by "Dr. K. Eric. Drexler"

Q.3. Why is Nanotechnology called as General Purpose Technology?

Ans. Nanotechnology is often referred to as general purpose technology because in its advanced form it will have significant impact on almost all industries and all areas of society.

Q.4. Write the uses of Nanotechnology?

Ans. The uses of Nanotechnology are:

(i) Nanoparticles, Nanopowers and Nanotubes play a signify cant rolein Industry, Environmental, Remediation, Medicine science and household.

(ii) Rear earth Nanoparticles and rare earth oxide powders are used as enhanced fiber optic amplification (EDFA) to remove phosphate in blood of patients with Hyperphosphatemia.

(iii) Iron Nanoparticles, Iron oxide nanopowders, cobalt Nanoparticles called Magnetic Nanoparticles are used for treatment of cancer, magnetic storage and magnetic resonance imaging(MRI)

(iv) Carbon Nanotubes are single walled, double walled and multiwalled black nano scale cylindrical tubes of graphitic carbon. They are stiffest and strongest fibers which have unique electrical properties. They are used in flat screen displays, scanning probe microscopes, sensing devices, body armors, tear resistant cloth fiber, and lighter sport equipments.

(v) Used in solving world energy crisis they are used as solid oxide fuel cells e.g.: Lanthanum Nanoparticles, cerium NO strontium carbonate Nanoparticles, manganese Nanoparticles, Manganese Oxide Nanoparticles, nickel oxide Nanoparticles silicon particles are used in solar energy cells

(vi) Used in making transparent sunscreen e.g.: TnO, Silver Nanoparticles

(vii) Also used as antimicrobial, antibacterial , antibiotic and antifungal agents when used in coatings, fibers, polymers, plastic, soaps and textiles

(viii) Used as super conductors, electric conductors, semiconductors in high speed computing, telecommunication and space travel e.g. Carbon Nano Tubes, Si02

(ix) Used in plastic nanocomposities for strong, lighter and rust proof car components e.g. Toyota is using Nanoparticles in making bumper which are lighter, resistant to denting and scratching. Carbide Nanoparticles, silicon carbide Nanoparticles, titanium carbide Nanoparticles

(x) Used as catalyst in chemical synthesis, chemical treatment and chemical cracking as they have extremely his surface area. E.g. Platinum Nanoparticles, Palladium Nanoparticles, gold Nanoparticles, Molybdenum Nanoparticles.

(xi) Used in manufacture of artificial bone composites e.g. calcium phosphate, nanocrystals as they have strength.

(xii) In dental imaging e.g. tungsten oxide Nanoparticles as they are radiopaque for high quality X-ray resolution.

(xiii) Used to kill cancer cells & in MRI medical imaging e.g. magnetic Nanoparticles (xiv) Fluorescent Nanoparticles are used by biologist to stain and label cellular components.

(xv) Used as dehaloginating agents e.g. Nickel Nano crystals used to remove trichloroethylene(TCE) which is a common ground water contaminant

Q.5. Write a short note on future aspects of Nanotechnology?

Ans. Nanotechnology is expected to have an impact on nearly every industry.

(i) Research community is conducting experiments on production of Nanomaterials, nanoelectronics and bionanotechnology.

(ii) Application in production of Nanocomposites, antibacterial Nanoparticles and nanostructured catalyst in next 1-5 years.

(iii) In 5-15 yrs nanodevices will be used in medical treatments and diagnostics, sensors and faster computers.

(iv) Will be used in manipulating single atom/ molecules.

Q.6. Define self assembly and write its characteristics?

Ans. Self assembly is the fundamental principle which generates structural organization on all scales from molecules.

The characteristics of self assembly are:

(i) Can occur spontaneously in nature

(ii) It results in increase in internal organization of the system.

(iii) Have superior handling biocompatibility & functionality

(iv) It is a manufacturing method used to construct things at the micro scale.

(v) The final/desired structure is encoded in the shape and properties of molecules.

(vi) The synthesis involves a chemical process called convergent synthesis.

Q.7. What is Top down fabrication technique?

Ans. In top down fabrication a bulk material is reduced in size to nanoscale pattern. These seek to create smaller devices by using larger to direct their assembly.

Q.8. Define Electron beam Lithography and give its advantages?

Ans. It is a specialized technique for create integrated circuits at the nanoscale. Electron beam Lithography uses the beam of electrons to generate patterns on a

surface. Advantages of Electron beam Lithography are:

(i) It is one of the ways to beat the diffraction limit of light and make features in the submicrometer regime.

(ii) This form of lithography has found wide usage in research, but has yet to become a standard technique in industry. The main reason for this is speed.

Q.9. Write a short note on Nanoimprint Lithography?

Ans. One of the cheapest nanolithography techniques available for laboratories is Nanoimprint, and the resolution reached can be as low as 10 nm.

The principle of this tenichque is the embossing of a patterned mold is the heated resist. A stamp with suitable features sizes, the adequate polymer material to be printed and equipment for printing with adequate temperature and pressure control are the three pillars of Nanoimprint lithography. The first step in nanoimprinting is building a silicon relief mold using direct - write e- beam equipment. That is slow process where in each features is defined by rastering an electron beam across the wafer. But once the imprint mold has beam defined, it can be used to stamp out features with the small parallel speed of the mask-based exposure process.

Successful development of NIL can remove the main obstacle, cost, to Nanostructure commercialization and will make nanostructures easily accessible for industrial application.

Q.10. What is an Electron Microscope? Name five types of electron microscopes?

Ans. The electron microscope is a type of microscope that uses electron to create an image of the target. It has much higher magnification or resolving power than a normal light microscope. Different types of electron microscope are:

(i) Transmission Electron Microscope (TEM)

(ii) Scanning Electron Microscope (SEM)

(iii) Scanning Transmission Electron Microscope (STEM)

(iv) Reflection Electron Microscope (REM)

(v) Scanning Tunneling Microscope (STM)

Q.11. Give the drawbacks and the fields of applications of Transmission Electron Microscope?

Ans. The drawbacks of Transmission Electron Microscope are:

1. Require extensive sample preparation

2. Time consuming
3. The structure of sample may also be changed during the process
4. The field of view is small
5. Sample may be damaged due to electron beam

The two fields where TEM is being used are

1. For carrying out reconstruction of biological materials.
2. In metal science/ metallurgy of the specimens

Q.12. Give the different methods of sample preparation for an Electron Microscope?

Ans. Samples viewed under an electron microscope may be treated in many ways:

1. Cryofixation
2. Fixation
3. Dehydration
4. Embedding
5. Sectioning
6. Staining
7. Freeze-fracture
8. Ion Beam Milling
9. Conductive coating
10. Evaporation

Q.13. What is an Atomic Force Microscope? In detail explain its working?

Ans. The atomic force microscope is a very high resolution type of scanning probe microscope. The AFM was invented by Binning, Quate and Wang in 1986. It is one of the foremost tool for imaging, measuring and manipulating matter at nanoscale. A traditional AFM consist of the following parts:

1. Scanner
2. Sample surface
3. Cantilever and tip
4. Laser light
5. Photodiodes
6. Detector and feedback electronics

Working of AFM:

1. The AFM consists of a microscale cantilever with a sharp tip at its end that is used to scan the specimen surface.
2. When the tip is brought close to the sample surface, forces between the tip and the sample lead to a deflection of the cantilever.
3. The deflection is measured using a laser spot reflected from the top of the cantilever into an array of photodiodes.
4. The deflection is then detected by a detector.

Q.14. What are the advantages of Atomic Force Microscope over Scanning Electron Microscope?

Ans. The Atomic Force Microscope (AFM) has several advantages over the Scanning Electron Microscope (SEM) as:

1. AFM provides a 3D surface profile whereas SEM provides a 2D image of an object.
2. Samples viewed by AFM don't require any special treatments that could irreversibly change or damage the sample.
3. A SEM requires a vacuum environment for proper operation but AFM can work perfectly in air or liquid environment and thus living organisms can also be studied.

Q.15. What are Nanomaterials?

Ans. Nanomaterials or Nanocrystalline materials are materials possessing grain sizes on the order of a billionth of a meter.

Q.16. What are the properties of Nanomaterials?

Ans. The properties of Nanomaterials are:

(i) They are exceptionally strong

(ii) They are hard

(iii) They are ductile at high temperatures

(iv) They are wear resistant

(v) They are erosion-resistant

(vi) They are corrosion-resistant

(vii) They are chemically very active

Q.17. Name five widely used methods for production of Nanomaterials?

Ans. The five widely used methods to produce Nanomaterials are:

(i) Sol-gel synthesis
(ii) Inert gas condensation
(iii) Mechanical alloying
(iv) High energy ball milling
(v) Plasma synthesis
(vi) Electrodeposition

Q.18. Mention the applications of Nanomaterials ?

Ans. The applications of Nanomaterials are :

(i) Next generation computer chips
(ii) Kinetic energy penetrators with enhanced lethality
(iii) Better insulation materials
(iv) Phosphors for high-definition TV
(v) Low cost flat-panel displays
(vi) Tougher and harder cutting tools
(vii) Elimination of pollutants
(viii) High-energy density batteries
(ix) High-power magnets
(x) High-sensitivity sensors
(xi) Automobiles with greater fuel efficiency
(xii) Aerospace components with enhanced performance characteristics
(xiii) Better and future weapons platforms
(xiv) Longer-lasting satellites
(xv) Longer-lasting medical implants
(xvi) Ductile ceramics
(xvii) Large electrochromic display devices

Q.19. Explain Fullerenes?

Ans. Fullerenes are closed spherical carbon structures. Korto in 1985 first observed fullerenes. Fullerenes consist of C70, C76, C84, C240, C540 and so on. The fullerenes, being closed structures with zero genus, differ by their shape and symmetry. The fullerenes are potential nano-capsules. A common method used

to produce fullerenes is to send a large current between two nearby graphite electrodes in an inert atmosphere. The resulting carbon plasma are between the electrodes cools into sooty residue from which many fullerenes can be isolated. Fullerenes are:

1. Harder than diamond
2. Bind to specific antibiotics
3. Can target cancer cells
4. Sparingly soluble in toluene and carbon disulfide.
5. Have a deep purple color.
6. Dissolved in common solvents at room temperature.
7. Exist in two optical forms.

Q.20. What are Carbon Nanotubes and how are they produced?

Ans. Carbon nanotubes are the tubes made from grapheme plain, with one or more than one layers. Ijima first discovered carbon nanotubes. Carbon nanotubes are also called as a tube of graphite. Carbon nanotubes are nanoscopic structure made of carbon atoms in the shape of a hollow cylinder. The cylinders are typically closed at their ends by semi-fullerenes like structures. The carbon nanotubes are produced using four main methods:

1. Arc discharge of graphite electrodes in inert atmospheres
2. Pyrolysis of hydrocarbons over catalyst.
3. Laser vaporization of graphite targets.
4. Electrolysis of graphite electrodes in the molten salts.
5. Methane burning.

Q.21. Mention the properties and industrial applications of Carbon Nanotubes?

Ans. The properties of carbon nanotubes are:

1. Carbon nanotubes are metallic or semi conducting
2. Carbon nanotubes possess great strength
3. Carbon nanotubes are stable at high temperatures
4. Carbon nanotubes are stable in air environment
5. Carbon nanotubes are very strong against strong acids and high temperature
6. Carbon nanotubes have attractive emission characteristics
7. Carbon nanotubes have high electrical and thermal conductivity

The industrial applications of carbon nanotubes are:

1. Carbon nanotubes are molecular building blocks of nanotechnology.
2. Carbon nanotubes improve the performance of
   - Tiny sensors
   - Electronic and optical; devices
   - Catalysts
   - Batteries
   - Fuel cells
   - Solar cells
   - Drug delivery vehicles
3. Lithium batteries containing carbon Nanowires have double energy capacity.
4. Carbon transistors will soon replace silicon transistors.
5. Carbon nanotubes are used in making stronger and lighter tennis rackets.
6. Carbon nanotubes are used in making bullet proof jackets.
7. Carbon nanotubes are used to make plastic fire retardant.
8. Carbon nanotubes are efficient alternative to fossil fuels as they can store 65% of their weight hydrogen in them.
9. Wires made up of carbon nanotubes conduct more electricity than copper wires.
10. Carbon nanotubes are being used in space lift due to their good strength and light weight.
11. Carbon nanotubes are used for separation and storage of biological active materials and gases.

Q.22. What are Nanowires? Name five types of Nanowires?

Ans. Nanowires is a wire of dimensions of the order of a nanometer. They are also called as Quantum wires. Different types of nanowires are:

1. Metallic Nanowires e.g. Ni, Pt, Au.
2. Semi conducting Nanowires e.g. Si, InP, GaN.
3. Insulating Nanowires e.g. SiO_2, TiO_2.
4. Molecular Nanowires
   - Organic e.g. DNA
   - Inorganic e.g. $Mo_6S_{9-x}I_x$, $Li_2Mo_6Se_6$.

Q.23. Explain the structure of Nanowires?

Ans. The nanowires show peculiar shapes. Sometimes they can show noncrystalline order e.g. pentagonal symmetry or a helicoidal (spiral) shape. The lack of crystalline order is because nanowire is periodic only in one dimension. Hence it can assume any order in the other direction. Nanowires are observed spontaneously in nature. Nanowires can be either suspended, deposited or synthesized from the elements.

Q.24. Give the uses and applications of Nanowires?

Ans. The uses of nanowires are:

1. To create p-type and n-type semiconductors

2. To create active electronic devices

3. To build logic gates e.g. AND, OR, NOT, etc.

4. In digital computing

The applications of nanowires are:

1. as additives in advanced composites

2. as field emittors

3. as leads for biomolecular nanosensors

4. for metallic interconnects in nanoscale quantum devices

Q.25. What are Quantum Dots?

Ans. When two Nanowires acting as photon waveguides cross each the juncture acts as a Quantum Dot.

Q.26. What is the difference between Nanocones and Nanohorns?

Ans. Carbon Nanocones are made up of hexagonal plane with a different number of pentagonal defects. Carbon Nanohorns is a special class of Nanocones with exact five defects on the tip.

Q.27. Give three potential risks of Nanomaterials?

Ans. Potential risks of nanotechnology are:

1. The risk to health and environment

2. The risk by molecular manufacturing

3. Societal risks

Q.28. Mention the lab safety guidelines for handling Nanomaterials?

Ans. The lab safety guidelines for handling Nanomaterials are:

1. Avoid skin contact with nanoparticles.
2. Wear appropriate respiratory protective.
3. Use fume exhaust hoods to expel fumes.
4. Dispose off nanoparticles considering waste guidelines.
5. Vacuum cleaners used to clean nanoparticles should be properly tested.
6. Potential contamination in instruments should be evaluated.
7. Lab equipments and exhaust systems should be evaluated and repaired time to time.
8. Potential fire and explosive hazards should be kept in mind.
9. Use good general lab safety practices for hygiene plan.
10. Wear gloves, lab coats, safety glasses, face shields, closed toed shoes are needed.

Q.29. Define the term Biomimicry?

Ans. Biomimicry is a process of copying plants i.e. photosynthesis mechanism.

Q.30. Define Nanocomposites?

Ans. Nanocomposites are a large variety of systems such as 1-D, 2-D, 3-D and amorphous materials, made of distinctly dissimilar components and mixed at the nanometer scale.

Q.31. How can Nanocomposites be designed?

Ans. Nanocomposites can be designed by the following synthetic routes:

1. In situ intercalative polymerization (ISIP)
2. Monolayer intercalation followed by topotactic intralamellar solid state polymerization
3. Direct percipitative encapsulation

Q.32. Describe the applications of Nanocomposites?

Ans. The applications of nanocomposities are:

1. Particle loading2. Mechanical property improvement due to nanoparticle additions

3. Gas barriers

4. Oxygen barriers

5. Food packaging

6. Fuel tanks

7. Films

8. Environment protection

9. Flammability reduction

Q.33. What are Bio-nano Devices ?

Ans. Biomolecular nano devices, Biomolecular structures with mechanical functions, are ubiquitous in nature and are fundamental to the process and function of life. E.g. Membrane proteins and molecular machines.

Q.34. What is Nanobiology?

Ans. Nanobiology is the synergy of surface science and molecular biology. It symbolizes a path breaking evolution in biology. It is capable of unveiling many fundamental secrets of life forms.

Q.35. Give the four major aspects of Nanobiology?

Ans. The four major aspects of Nanobiology are:

1. Interaction between biomolecules and nanoparticle surfaces

2. Biological imaging using nanoparticles

3. Analytical applications of Nanobiology

4. Medical diagnosis and targeted drug delivery

Q.36. Name different types of inorganic materials used for the synthesis assemblies?

Ans. Different types of inorganic materials are:

1. Nobel metal materials

2. Semiconductor nanocrystals (Quantum dots)

3. Magnetic nanoparticles

Q.37. What are the properties of Quantum Dots?

Ans. the properties of Quantum dots are:

1. Narrow spectral line width
2. High luminescence
3. Continuous absorption profile
4. Stability against photo bleaching
5. Ideal immuno-labels for fluorescent imaging

Q.38. Mention the fields where magnetic nanoparticles can be used?

Ans. Magnetic nanoparticles have applications in the following spheres:

1. Proteomics
2. Molecular cell biology
3. Medical science
4. Analytical biochemistry
5. Clinical diagnostics
6. Microbiology
7. Immunology
8. Biotechnology
9. Targeted drug delivery

Q.39. Give the applications of Nanotechnology in Biology?

Ans. the applications of nano in biology are:

- Biological imaging using semiconductors nanocrystals
- Immuno fluorescent biomarker imaging
- Immunogold labeling
- Diagnostic applications of immuno-targeted nanoparticles
- Targeted drug delivery using nanoparticles

Q.40. What is Bioinformatics?

Ans. Bioinformatics is the application of information technology to the field of molecular biology.Bioinformatics entails the creation and advancement of databases, algorithms, computational and statistical techniques, and theory to solve formal and practical problems arising from the management and analysis of biological data. Bioinformatics is that branch of life science,which deals with the study of application of information technology to the field of molecular

biology. Bioinformatics is the use of IT in biotechnology for the data storage, data warehousing and analyzing the DNA sequences.

Q.41. Give the major research areas of Bioinformatics?

Ans. The major research areas of bioinformatics include :

1. Sequence analysis
2. Genome annotation
3. Computational evolutionary biology
4. Measuring biodiversity
5. Analysis of gene expression
6. Analysis of regulation
7. Analysis of protein expression
8. Analysis of mutations in cancer
9. Prediction of protein structure
10. Comparative genomics
11. Modeling biological systems
12. High-throughput image analysis
13. Protein-protein docking
14. Software and tools
15. Web services in bioinformatics

Q.42. What is a biological database?

Ans. A biological database is a large, organized body of persistent data, usually associated with computerized software designed to update, query, and retrieve components of the data stored within the system. A simple database might be a single file containing many records, each of which includes the same set of information.

Q.43. Define Gene Bank?

Ans. Gene Bank (Genetic Sequence Databank) is one of the fastest growing repositories of known genetic sequences. It has a flat file structure that is an ASCII text file, readable by both humans and computers. In addition to sequence

data, GenBank files contain information like accession numbers and gene names, phylogenetic classification and references to published literature.

Q.44. Describe EMBL?

Ans. The EMBL Nucleotide Sequence Database is a comprehensive database of DNA and RNA sequences collected from the scientific literature and patent applications and directly submitted from researchers and sequencing groups. Data collection is done in collaboration with GenBank (USA) and the DNA Database of Japan (DDBJ). The database currently doubles in size every 18 months.

Q.45. What is Swiss port?

Ans. Swiss Port is a protein sequence database that provides a high level of integration with other databases and also has a very low level of redundancy (means less identical sequences are present in the database).

Q.46. What is GDB?

Ans. The GDB Human Genome Data Base supports biomedical research, clinical medicine, and professional and scientific education by providing for the storage and dissemination of data about genes and other DNA markers, map location, genetic disease and locus information, and bibliographic information.

Q.47. Explain PIR-PSD?

Ans. PIR (Protein Information Resource) produces and distributes the PIR-International Protein Sequence Database (PSD). It is the most comprehensive and expertly annotated protein sequence database. The PIR serves the scientific community through on-line access, distributing magnetic tapes, and performing off-line sequence identification services for researchers.

Protein sequence databases are classified as primary, secondary and composite depending upon the content stored in them. PIR and SwissProt are primary databases that contain protein sequences as 'raw' data. Secondary databases (like Prosite) contain the information derived from protein sequences. Primary databases are combined and filtered to form non-redundant composite database.

Q.48. Write a short note of origin of Bioinformatics?

Ans. There are different views of origin of Bioinformatics. "The term bioinformatics is used to encompass almost all computer applications in biological sciences, but was originally coined in the mid-1980s for the analysis of biological sequence data." :"The term "bioinformatics" is a relatively recent invention, not appearing

in the literature until 1991 and then only in the context of the emergence of electronic publishing. The first bioinformatics/biological databases were constructed a few years after the first protein sequences began to become available. The first protein sequence reported was that of bovine insulin in 1956, consisting of 51 residues. Nearly a decade later, the first nucleic acid sequence was reported, that of yeast alanine tRNA with 77 bases. Just a year later, Dayhoff gathered all the available sequence data to create the first bioinformatics database. The Protein Data Bank followed in 1972 with a collection of ten X-ray crystallographic protein structures, and the SWISS PROT protein sequence database began in 1987. A huge variety of divergent data resources of different types and sizes are now available either in the public domain or more recently from commercial third parties

Q.49. What are major categories of Bioinformatics Tools?

Ans. The major categories of Bioinformatics Tools are:

1. Homology and Similarity Tools
2. Protein Function Analysis
3. Structural Analysis
4. Sequence Analysis

Q.50. Name some Bioinformatics Tools?

Ans. Some Bioinformatics Tools are:

1. BLAST - Basic Local Alignment Search Tool
2. FASTA - FAST homology search All sequences
3. EMBOSS - European Molecular Biology Open Software Suite
4. Clustalw
5. RasMol
6. PROSPECT - Protein Structure Prediction and Evaluation Computer Tool Kit
7. Pattern Hunter
8. COPLA- Consensus Pattern Identification and Analysis

Q.51. Give the applications of Bioinformatics?

Ans. Bioinformatics is being used in following fields:

- Molecular medicine
- Personalized medicine
- Preventative medicine
- Gene therapy
- Drug development
- Microbial genome applications
- Waste cleanup
- Climate change Studies
- Alternative energy sources
- Biotechnology
- Antibiotic resistance
- Forensic analysis of microbes
- Bio-weapon creation
- Evolutionary studies
- Crop improvement
- Insect resistance
- Improve nutritional quality
- Development of Drought resistance varieties.
- Vetinary Science

Q.52. Write a short note on Human Genome Project?

Ans. In 1988, the Human Genome organization (HUGO) was founded. This is an international organization of scientists involved in Human Genome Project. In 1989, the first complete genome map was published of the bacteria Haemophilus influenza. By 1991, a total of 1879 human genes had been mapped. In 1993, Genethon, a human genome research center in France Produced a physical map of the human genome. Three years later, Genethon published the final version of the Human Genetic Map. This concluded the end of the first phase of the Human Genome Project.

Q.53. What is BLAST?

Ans. BLAST (Basic Local Alignment Search Tool) comes under the category of homology and similarity tools. It is a set of search programs designed for the Windows platform and is used to perform fast similarity searches regardless of whether the query is for protein or DNA. Comparison of nucleotide sequences in a database can be performed. Also a protein database can be searched to find a match against the queried protein sequence. NCBI has also introduced the new queuing system to BLAST (Q BLAST) that allows users to retrieve results at their convenience and format their results multiple times with different formatting options.

Depending on the type of sequences to compare, there are different programs:

- blastp compares an amino acid query sequence against a protein sequence database
- blastn compares a nucleotide query sequence against a nucleotide sequence database
- blastx compares a nucleotide query sequence translated in all reading frames against a protein sequence database
- tblastn compares a protein query sequence against a nucleotide sequence database dynamically translated in all reading frames.
- tblastx compares the six-frame translations of a nucleotide query sequence against the six-frame translations of a nucleotide sequence database.

Q.54. Explain FASTA?

Ans. **FAST** homology search All sequences An alignment program for protein sequences created by Pearsin and Lipman in 1988. The program is one of the many heuristic algorithms proposed to speed up sequence comparison. The basic idea is to add a fast prescreen step to locate the highly matching segments between two sequences, and then extend these matching segments to local alignments using more rigorous algorithms such as Smith-Waterman.

Q.55. Give the applications of JAVA and Perl in Bioinformatics?

Ans. The Applications of Programs in Bioinformatics are:

1. JAVA in Bioinformatics: Since research centers are scattered all around the globe ranging from private to academic settings, and a range of hardware and OSs are being used, Java is emerging as a key player in bioinformatics. Physiome Sciences' computer-based biological simulation technologies and Bioinformatics Solutions' PatternHunter are two examples of the growing adoption of Java in bioinformatics.

2. Perl in Bioinformatics: String manipulation, regular expression matching, file parsing, data format interconversion etc are the common text-processing tasks performed in bioinformatics. Perl excels in such tasks and is being used by many developers. Yet, there are no standard modules designed in Perl specifically for the field of bioinformatics. However, developers have designed several of their own individual modules for the purpose, which have become quite popular and are coordinated by the BioPerl project.