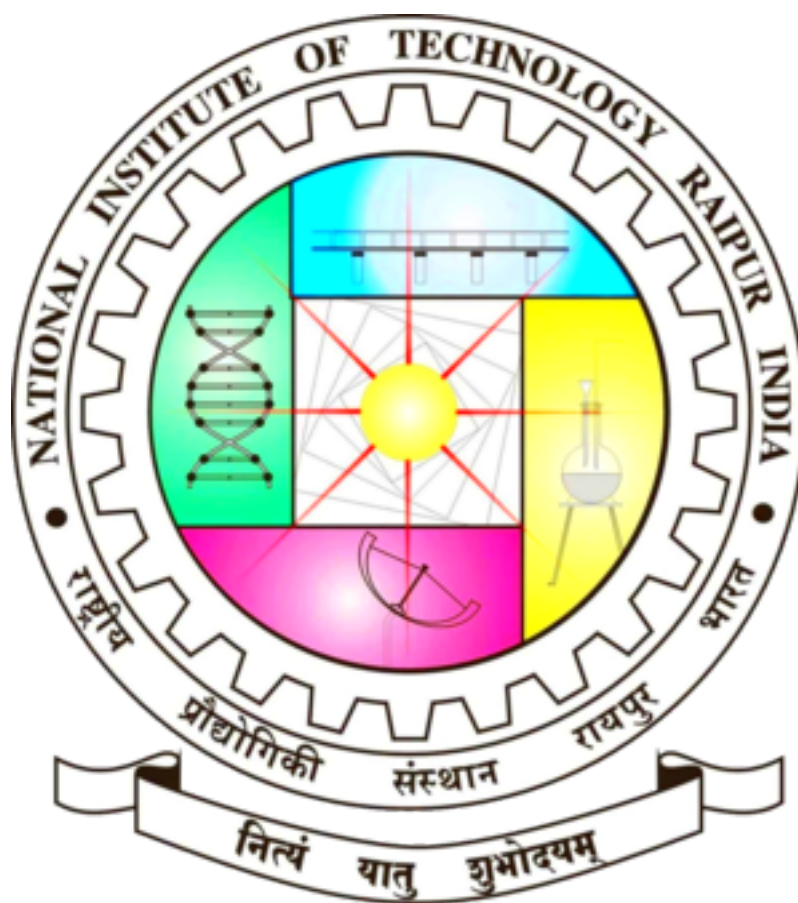


PROJECT REPORT ON BIOINFORMATICS AND ITS APPLICATIONS

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1 ABSTRACT

This paper will cover the role of bioinformatics in modern healthcare sector. Also , it will analyze its importance in shaping current medical technologies. It will cover topics like the foundation of bioinformatics and some real life applications associated with it. Right from its roots to future prospects will be covered in this paper.It will discuss about the major applications like proteomics, genomics, precision medicine, etc. There is also an small real life application mentioned in here. At last it will discuss few companies working in this field and future growth of it..

2 INTRODUCTION:

In modern day time , computational approaches are used in every walk of life. Let it be finance , engineering, etc. Computers have changed our lives in such a great way that it is beyond thinking that with just a click one can order something from miles and miles away from us. With a such an power and potential to revolutionize the world , computers and computational approaches make up the solution which has always tricked our mind and that is what are we made of, how such complex machine of ours works. To answer all such questions a new term was introduced by Paulien Hogeweg and Ben Hesper in 1970. The literal meaning of the term “Bioinformatics” is decoding and better analysis of biological data using algorithms and softwares. It is a mix of Biology, Computer science, Information Technology , Data science and Mathematics . It emphasizes on studying biological process. The field of bioinformatics experienced explosive growth starting in the mid-1990s, driven largely by the Human genome sequencing and by rapid advances in DNA sequencing technology...

3 MAJOR APPLICATIONS OF BIOINFORMATICS INCLUDE:

1) Proteomics- Proteomics include systematic study of proteomes (which are set of proteins produced in living organisms). Proteomics helps in discovery of proteins which are useful for better understanding and provide solutions to problems like tumor metastasis , urological cancer reasearch , diabetes research , fetal medicine , antibody profiling for better study and treatment of new diseases. Also, in couple of years during Covid-19 pandemic proteomics has contributed a lot for understanding (Sars-cov-2) and vaccine development. Proteomics mainly helps in the following segments: a) Protein identification b) Protein Localization c) Protein Quantification d) protein-protein interactions. Two major use cases are

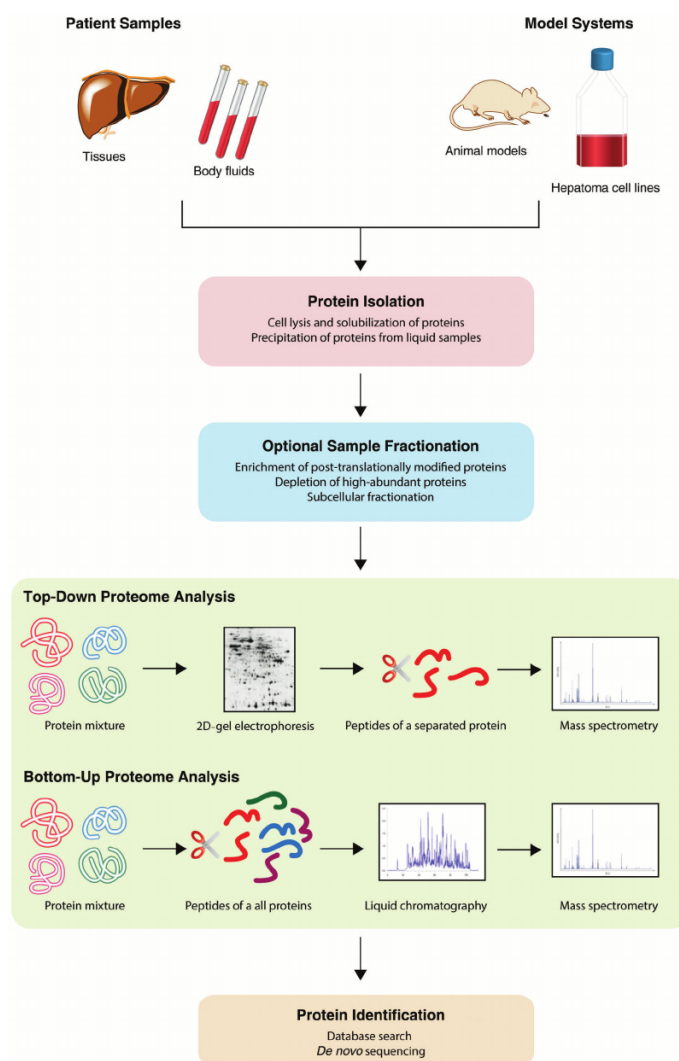
A) BIOMARKERS-

Biomarkers are considered as objectively measured and evaluated as a indicator of normal biological process, pathogenic process and pharmacological responses. Proteomics is used for identifaction of specific biomarkers and identification of specific immunohistochemistry which help in diagnosis of

disease.

B) DRUG DISCOVERY-

With help of computer softwares it is possible for identification of proteins of diseases for development of potential drugs.. **Here is an example of Proteomics work flow:**



2) GENOMICS- Genomics is study and analysis of genes. It focuses on studying the evolution of genes of humans or animals , even plants. Genomics uses techniques like DNA sequencing methods , where bioinformatics is used for analysis and studying genomes. Genomics are mainly used for development of medicines. Using Informatics data is integrated for better understanding of genomic data and understanding drug response.

3) PRECISION MEDICINE- Precision medicine which is a personalized approach of treatment of diseases and prevention of them. It includes development of devices that track personal health information, analysis of family medical history for finding most likely medical condition in future, Artificial Intelligence is used for development of better and more accurate medicinal approaches. Machine learning algorithms are used for genome sequencing to draw inferences from patients healthcare data. Bioinformatics is used in precision medicine for implementation and execution of patients omic data , it is also used for detection of altered genes, it is used for establishing therapeutic guidance of patients medical data and genomic profile.

4 AN USE CASE OF BIOINFORMATICS:-

Here is an example of Homo sapiens BRCA1 associated protein 1 (BAP1) on chromosome 3, which is an human tumor suppressor gene. We will analyze the number of nucleotides and also the GC content in them.

Here is an FASTA of its nucleotide:

https://www.ncbi.nlm.nih.gov/nuccore/NG_031859.1?report=fasta

After implementation of code the output is:

```
Last login: Tue Mar 26 21:31:59 on ttys001
Blake-Allens-MacBook-Pro:~ blakeallen$ cd /Users/blakeallen/SS/howToBioinformatics/casts/python001
Blake-Allens-MacBook-Pro:python001 blakeallen$ ls
BRCA1_BAP1.txt gc.py          gc2.txt          gc3.py
Blake-Allens-MacBook-Pro:python001 blakeallen$ python gc.py
number of g's 4375
number of c's 4325
number of a's 3372
number of t's 3914
gc content: 0.544226197923 I
```

- 5 TOOLS AND SOFTWARES USED:** The range of open-source software packages includes wide variety of titles like Bioconductor, BioPerl, Biopython, BioJava, BioJS, BioRuby, Bioclipse, EMBOSS, .NET Bio, Orange with its bioinformatics add-on, Apache Taverna, UGENE and GenoCAD.
- 6 GLOBAL COMPANIES ACTIVELY WORKING IN THE FIELD OF BIOINFORMATICS:**

1)SEVEN BRIDGES:

Products and services- It is a cloud-based platform used for bioinformatics analysis. Graph genome suite an set of bioinformatics tools used for whole-genome sequencing data.

2) X-CODE LIFE SCIENCES:

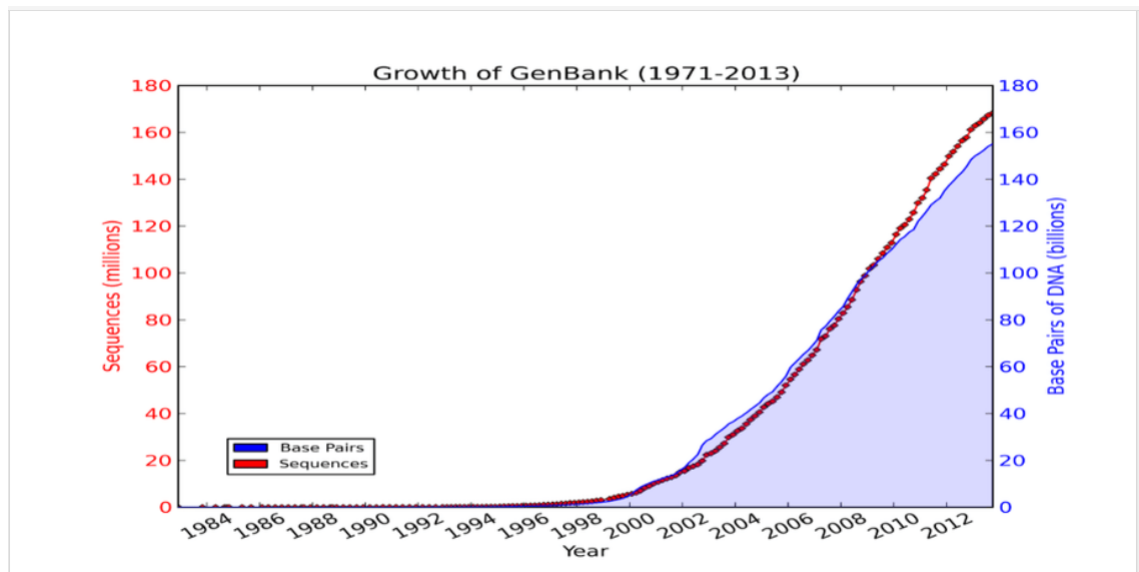
Products and services- Using advanced computing, genomics, informatics and domain knowledge , X-Code aims at building personalized medical solutions specializing in preventive medicine healthcare segment.It is an Indian startup founded in 2010 by Abdur Rub, Naru Narayanan, Saleem Mohammed.

3) GENEDATA:

Products and Services- Genedata is a switzerland based startup that provides software solutions to biotechnology, pharmaceutical , agricultural sector. Genedata analyst helps in interpretation and integration of research and development data. Genedata selector works in management and analysis of genomic data.

7 FUTURE PROSPECTS OF BIOINFORMATICS

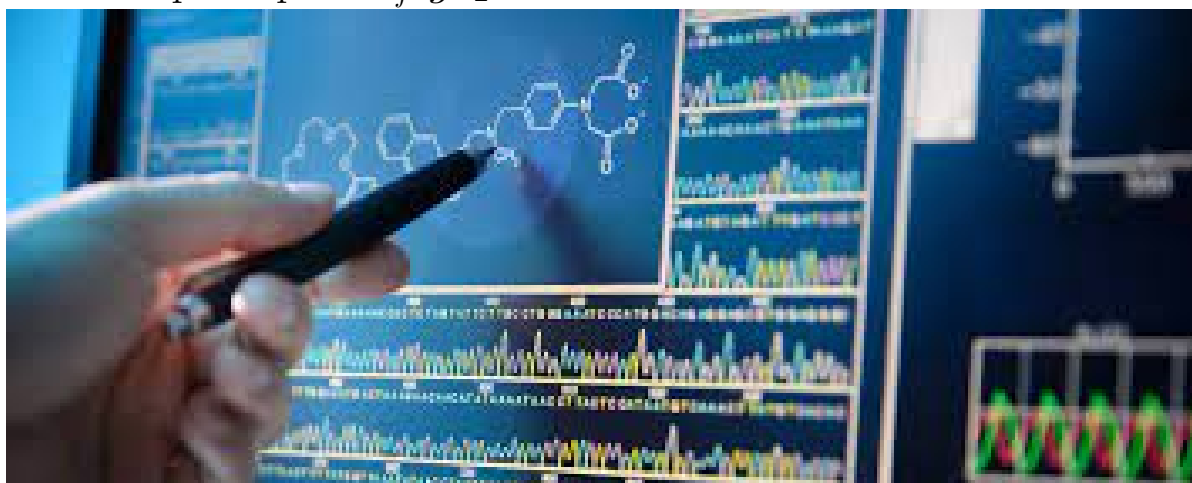
Currently, the field is undergoing an enormous expansion, as witnessed by the astonishing increase in the number of advertisements for bioinformatics personnel during the past year. Here we have an graph showing us the increased number of Genbank which clearly indicates the changing phase of Bioinformatics.



In future the demand for people working in the field of bioinformatics will increase rapidly, because of advancements in more proficient software tools and increase in data management systems. In future it might be very common to know about personal genetic information and predict risks from chronic diseases. Also, advancements in bioinformatics would lead to easy detection of genetic code of viruses, thus reducing time for development of vaccines and medicines.

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.....**THANK YOU**.....