A Dummies' Intro to Bioinformatics

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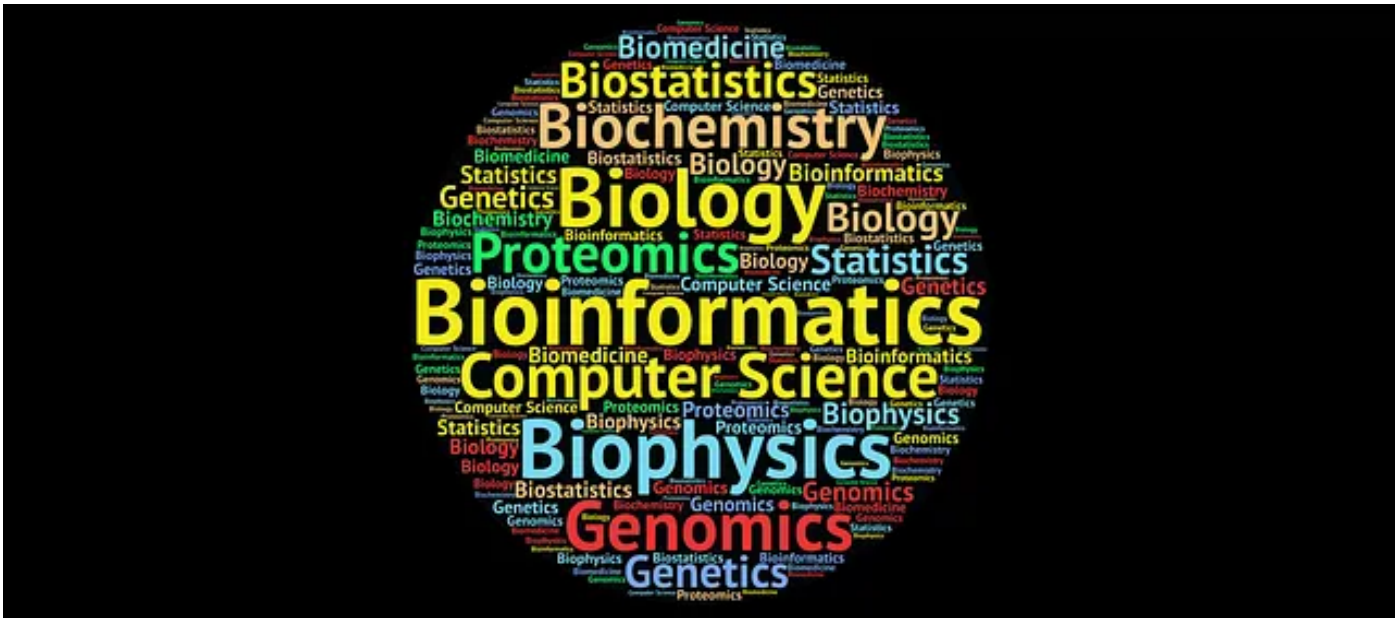

Bioinformatics and related fields

The word ***Bioinformatics*** is making quite a turnaround in today's world of Science. The word seems to be made up of two parts which are related to two different fields, **biology** and **computer science**. About one or two decades ago, people saw biology and computer science as two entirely different fields. One would learn about living beings and their functions whereas the other would learn about computers and underlying theories.

Let's save the detailed talk for later. If you have no clue about this newly emerging field, you have come to the right place. In this article, I will explain about this field as simply as possible, without going deep into biology nor computer science.

What is Bioinformatics?

> **bio + informatics = bioinformatics**

According to Wikipedia,

> ***Bioinformatics*** *is an interdisciplinary field that develops methods and software tools for understanding biological data. As an interdisciplinary field of science, bioinformatics combines computer science, statistics, mathematics, and engineering to analyze and interpret biological data.*

With emerging new concepts, theories and techniques in biological analysis, a huge amount of data is being collected by scientists after conducting various experiments. Though the amount of data grows exponentially, it becomes impractical to analyze them manually. This is where computer science techniques intervene together with statistics, mathematics and engineering. Computational techniques are used to analyze these large amounts of data more accurately and efficiently. Hence, bioinformatics can be considered as a field of data science for solving problems in biology.

Experiments then and now

Before the emergence of bioinformatics, there were only two ways to conduct biological experiments.

1. Within a living organism (***in vivo,*** meaning ***in living*** in Latin)
2. In an artificial environment (***in vitro***, meaning ***in glass*** in Latin)

In vitro and in vivo experiments (Image Source: http://www.invivotransfection.com)

The field of bioinformatics is considered as ***in silico*** (meaning ***in silicon*** *in Latin*), where we conduct biological experiments in a silicon chip, or more accurately in a microprocessor. One major advantage of in silico methods is that you can run simulations and carry out experiments without using any animals or reagents. This will be on the good books of animal rights activists. 😊

Why Learn Bioinformatics?

Bioinformatics has become an essential interdisciplinary science for life science and biomedical sciences. If you are a biologist, you will find that having knowledge in bioinformatics can benefit you immensely with your experiments and research.

The current job industry is full of vacancies for people with skills in bioinformatics. Science Mag states that major pharmaceutical, biotech and software companies are seeking to hire professionals with experience in bioinformatics where they will be working with huge amounts of biological and health care information. Check out Indeed.com to see several job opportunities in the field of bioinformatics.

Apart from the jobs and career requirements, if you love both biology and computer science, then this field is for you. As a computer science undergraduate who loves biology and is currently studying bioinformatics, trust me when I say this, you will definitely love this field.

What will You Learn in Bioinformatics?

First of all, you will have to learn a bit about biology; **genetics and genomics** to be specific. This will include studying genes, DNA, RNA, protein structures, etc.

Then you will have to study **biological sequences** (for example, sequences found in DNA, RNA and proteins) and techniques to discover and analyze various patterns in them. You will come across various algorithms used by different techniques.

Since you will be dealing with large amounts of data, it is crucial to have a good understanding of **statistics** as you have to analyze data according to specific requirements. Hence, you will be learning quite a lot about statistics as well.

Of course, you will need **programming** skills. R, Python, and Bash are the most useful, commonly used programming languages. Deciding which one to start with depends on your goals. I selected Python. 🐍 You can use other languages such as C/C++ and Java as well.

After having a basic understanding of the fundamental concepts, you can proceed to learn about other areas such as **structural bioinformatics, systems biology** and **biological networks**.

Applications of Bioinformatics

According to Science Daily, bioinformatics is being used in many different aspects including **DNA sequences**, **genes**, **proteins** and **modeling of evolution**. We will not go into details of these.

A well-known application of bioinformatics is in the fields of **precision medicine** and **preventive medicine**. In precision medicine, health care techniques for individual patients are being customized accordingly, including treatments and practices. Rather than treating or curing diseases, precision medicine consists of developing measures to prevent diseases. Some of the focus areas of these fields are **influenza**, **cancer**, **heart disease** and diabetes. Researches have been carried out to identify ***genetic alterations in patients*** allowing scientists to come up with better treatments and even possible measures of prevention. You can read more about the role of bioinformatics in cancer treatment from this article by the National Cancer Institute.

Disease Identification

Another important application of bioinformatics is for creating drugs. We can understand the disease using computational tools, identify the disease cause and treat with suitable drugs accordingly, rather than merely treating

the symptoms.

These are a few of the applications of bioinformatics. There are many more situations where the knowledge of bioinformatics is used, including microbiology, gene technology and agriculture.

Final Thoughts

It has been a few weeks since I started learning bioinformatics and I have become very interested in it. I have been doing a bit of reading and would like to recommend the following books.

1. ***Bioinformatics for Dummies*** by *Cedric Notredame and Jean-Michel Claverie*
2. ***Bioinformatics for Beginners: Genes, Genomes, Molecular Evolution, Databases and Analytical Tools*** by *Supratim Choudhuri*
3. ***Bioinformatics Programming in Python: A Practical Course for Beginners*** by *Ruediger-Marcus Flaig*
4. ***Bioinformatics Programming Using Python*** by *Mitchell L. Model*

I think these books are excellent for beginners. After reading these you will get a good foundation and understanding of the basic concepts and start off programming as well.

Since I'm still very new to this field, I would like to hear your advice. 😇

I hope you got a basic idea of bioinformatics.

Thanks for reading...! 😃