

Short Communication

Life Paradigm and BT / IT = Bioinformatics

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ABSTRACT

India's biotechnology industry has four important core sectors that are (i) Innovation (ii) entrepreneurship (iii) developing human resource and (iv). high quality research and patient care by using various advanced research methodologies and tools available through research & development in the country. Bio-IT and health care in India is the need of present generation. Bioinformatics is a promising field in India's biotechnology sector. Its market size is significantly evolved over the past few decades despite contribution of nearly 2% of the overall biotech industry. Bio-IT and health care are presently in forefront revolution in the country. Despite the economic downturn in 2013-14, the industry experienced rapid growth of 20% on account of increasing foreign investment. In India, the Industry players and academic institutions should develop highly qualified manpower for computational science approaches with a proven track record in Bio-IT field. During pre independence time, the importance of information system was recognized by Bhore Committee (1946) and later Bajaj Committee in addition to the high level Expert group set up for health. however, in 1983 its significant was highlighted in National Health Policy of India. DBT as an apex body is funding research initiatives for a key role in the development of the country and credited for the establishment of BTISnet in 1987. This is one of the largest network world wide having Centre of Excellence (CoE), Distributed Information System (DIC), Sub-DIC and Bioinformatics Infrastructure Facilities (BIF) include super computer and graphic facility in Bioinformatics. Some of the other Bio-IT sectors in India are CSIR, Deity, DST, MoHFW and ISRO have initiated projects that aim to utilize India's IT skills. In addition to the allocation of five year plans, these Govt. bodies owing to the potentials and capabilities of health informatics for improving health care in the country and delivery to the common man by supporting system for information management and health care delivery. A biotechnologist better knows that the science is unraveling how genes influence behavior apart from core IT sector in this new age of biology. To determine the idea that all characteristics are hard-wired by the genome, the important tasks are to understand the known sequences and on other side it may go as genome -> protein -> drug towards drug development from computational perspectives. The present scenario is to ensure that the existing BT/IT is to develop an excellence with sub minimal facilities to facilitate the sheer knowledge for carrying out any intense modeling and simulation activity, method, development and manpower training to harness country's potential for launching research initiatives among the scientific community.

Key Words: Bioinformatics, Genomics, Sequence, Databases

Life is probably the most complex of processes. In today's globally computerized environment, these complex problems can be looked on and solved with the use of modern computational approach and

analysis for understanding its manifestations. Biotechnology is a Science dealing not only with complex processes of life, structures, phenomenon of various organelles but also deals with the changes, which occurred either biologically or naturally. Efforts are taken by research output and field trials undertaken with various species for their better yields. The basis of biotechnological research is to show good results which help to persist the human life. All the areas today whether it is agriculture, medical, Industrial,

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plant sciences, pharmaceuticals, food biotechnology, Bioinformatics are now having diversion towards this area to brought out the product based science using modern tools and techniques. The modern infrastructure available with the Institutions are not only helps in structure predictions of various molecules but ease the science at laboratory level too, where lot of thrust is required. The current software tools now support the work to formulate and analyze these experiments more promptly and accurately.

In basic biotechnology R&D the natural products, genes and microorganism itself serves as a *tool* and helps to get the better products by exploiting natural resources. They help in making the crop genetically modified called as “transgenic” and enhanced their capabilities and production. Applying these tools and techniques, we have achieved enormous success in improving our crops and also produced various products indigenously such as vaccines etc. The product from these R&D research are less harmful, as it seems natural product itself serves and enhance the capability by adding genes and nutritive contents of the product (s) which generate by changing in their genetic mapping. The studies for their safety guidelines are also followed and are underway to make it totally free for any harmful effect.

The inner core of biotechnology is the way of science which helps to deal with large number of studies related to cells, amino acids, nucleotide bases and molecules. This is also a science for commercialization and scale up of its products. Biotechnology also has a great thrust in the area through modern computational approaches which is known as Bioinformatics. Using Bioinformatics applications and R & D approaches, Biotechnology stimulates, nurture and expand the area of human knowledge.

In India, Bioinformatics combines the study in Biotechnology using IT and computational applications is flourishing through various Centers in the form of BTISnet Centers under the BTISnet program of the Department of Biotechnology. These Information Centers (Bioinformatics Centre) established all over the country for pursuing research and creating infrastructure for various teaching programs in Biotechnology. Likewise the health informatics sector is set to attract interest from the Govt. and Private sector. BTISnet Centres also supports the courses and

training programs in their specialized area using the facilities and available resources. These Centers are located to work under different sectors and initiated in Universities and Research Institutions at various geographical locations in the country. By the strong network the Bioinformatics made an alignment with the Centre which currently providing services to biotechnologist through major data bases available on the web search engines and various other analysis tools, which can be accessible through Internet are in widely use by the scientific community particularly in the area of Biotechnology.

Application of Bio-IT has been widespread across all facets of Medicine – from clinical research to drug development and personalized medicine. The whole communities of biological scientists are now using the immense information resources that are becoming available hosted in the servers which have a major impact on future programs improving R&D and human and environmental health related issues. In fact the communication network is playing a vital role in spreading up of biotechnologies, which leads to development towards a modern era.

The advancement in Information Technology has also accelerated the pace of information exchange and the interface of computers to biological data. Most technical papers in molecular biology present DNA/RNA sequences are now available on Internet. Many difficulties which may arises during R&D in manipulation the information and avoiding errors in transcription can be sorted out. Attempts are in progress to make the records of these findings in computer based system and more than 500000 bases covering the entire living kingdom have been reported and registered in the scientific literature. About 1,000 proteins have been characterized in some details. A few organism genomes have been totally sequenced. It is difficult to mention the sequence output statistics, because every time the list is updated with new sequences (unfinished and finished data).

DNA sequences and databases can forego various kinds of mathematical and statistical manipulations and analysis. To manage and analyze the ever increasing volume of data techniques of Information Technologies helps in new algorithms developed through computer’s programming and are available to perform the functions such as:

- ✓ Generate list of restriction sites and constructs restriction maps.
- ✓ Translate the DNA Code into amino acid sequences, in the three possible reading frames and develop method to predict the structure and/or function of newly discovered proteins and structural RNA Sequences.
- ✓ Discover relations between sequences and aligning similar proteins and generating phylogenetic tree to examine evolutionary relationship.
- ✓ Perform a variety of statistical analysis, including codon usage (distribution of triplets) and amino acid distribution.
- ✓ Clustering protein sequences into families of related sequences and the development of protein models.
- ✓ Display this information in tabular and graphical forms.

Bioinformatics mainly concern with creation and maintenance of data bases of biological information. Some of popular sequence databases, such as GenBank, EMBL, have been growing and produced at phenomenal rate. On an average these databases are doubling in size every 15 months.

Proteins are sequences of amino acids and are common place to define their level of organization as primary, secondary, tertiary and quaternary structures. The proteins are normally biologically active only when folded in its tertiary form. The quaternary structure is the organization of the proteins into well – defined domains. A large number of literatures exist on modeling and predicting the secondary and tertiary structure of proteins. It is possible to predict the three - dimensional structure of a protein using algorithms that have been derived from our knowledge of Physics, Chemistry and most importantly, from the analysis of other proteins with similar amino acid sequences. Computer modeling is being applied extensively to such problems of chemistry and biochemistry as chemical kinetics, membrane transport phenomena, drug receptor dynamics, structure active relationships, drug design, antigen – antibody interaction and biomolecular sub assembly. The ultimate goal is to understand the activity of proteins and direct them against substrates of interest. Protein scientists have for years built “stick and ball” models of proteins to obtain a visual three

dimension representation of large molecules. The machinery of every human mind and body is built and run with fewer than 100,000 kinds of protein molecules. And for each of these proteins we can imagine a single corresponding gene responsible for its adequate and timely supply. Most surprising still, the difference between two unrelated individuals may reflect a mere handful of differences in their genomics recipes. Scientist suggest that the genetic key to human complexity lies not in the number of genes but in how gene parts are used to build different products in a process called alternative splicing. Other sources of added complexity are the thousands of post translational chemical modifications made to proteins and the repertoire of regulatory mechanism controlling these processes.

The advent of computers with sophisticated multicolor graphic limited imagination, we can predict computers involved in designing experiments, developing strategies and testing schemes, analyzing results and projecting new options and possibilities. Much of the routine work of biotechnology (sequencing, pattern recognition, and information storage, monitoring of experiments) will be left to the challenge of Bioinformatics. Bioinformatics also refers in any application of computation to the field of biology including data management, data mining and algorithm development. It also helps in acquiring, storing, analyzing and interpreting biological data to solve biological questions. Bioinformatics allows scientist to see the difference in the DNA sequence among individuals and affect relationship between disease and polymorphism. *In-silico* functional assignment is primarily achieved based on the sequence similarity to other proteins in the Database whose function has been determined biochemically.

Biotechnology R&D has already made significant achievements in the area of agriculture, Industry, Pharmaceuticals and Medical sectors all over the world. Similarly, the Bioinformatics are now become a largely known discipline world over and emerging very fast even in the area of Medicine. Advances in the sequencing of genomes have facilitated target selection and Bioinformatics plays a major role. Recognition of new member of super families, where member have already proved to be useful drug targets, is providing useful in exploiting genome analysis for discovery of new therapeutic agents. Hence, Bioinformatics is a modern approach which constitute

the modern scientific environment and infrastructure which helps to unfold the complex problems and also unravel the science which began with the discovery of DNA structure and ends in miraculous findings leads to recognize the computational approach and importance of Information Technology in present scenario to pursue advanced studies in modern biology and Biotechnology.

In the last few decades, advances in molecular biology and developed infrastructure facilities for Research in this field have allowed the increasing and rapid sequencing of large portions of the genomes. The first International congress of Human Genetics was held in Copenhagen in 1956. Since then, the study of human genome (genetic complement of a cell) has advanced enormously. Genetic analysis is now being used to identify and detect human disease genes which will remarkably change the course of modern medicine. This ability to identify and pick out specific genes from the millions present in human genes is in/itself a remarkable achievement. The Human Genome Project (HGP), designed to sequence all 24 of the human chromosomes is almost complete and several draft have already been published.

Bioinformatics may be called as a brain box for biotechnological research. As molecular aspects for life helps in understanding the language, grammar, logic and mathematics of its own, likewise, there has been a proliferation of computer programs includes applications, algorithms, languages etc. by which we can understood the current and modern research even

in few seconds. Huge databases are available on computer now to know about the sequences. With such diversifying approaches biologists are now become a computer specialist and simultaneously they are utilizing the full use of the available resources and capabilities generated through Bioinformatics. Generally, bioinformatics is the application of computer technologies to the biological sciences, particularly genomics. It can be defined as integrated science of Biotechnology and Information Technology or Bio-IT. The analysis of genome sequences for *abinitio* gene prediction, homology studies, motif analysis and other non-empirical methods are being followed on the premises of what is known as “Genomics” functional annotation of every gene in the genome through the computational methods implies a capability for a particular function related to the gene.

To capitalize on bio-IT global potential the primary challenge threatening India’s healthcare is the low level of spending on medical, public health and family welfare activities, hence the global drug discovery process is undertaken through computational methodologies several Indian bioinformatics companies generate business by assisting their global counterparts in the drug development process at a lower cost. Discovering function of proteins based on various tools of comparative genomics is the real computer challenges for the technologist to go back to nature and the laboratory where his work began.

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