Bioinformatics Group

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Group members

Name	Titulus	Publications	CV
Zoltan HEGEDUS	Senior research associate	publications	CV
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Research

The current paradigm of molecular biology is shifting towards the interpretation of data produced by high-throughput methods. The new data sources allow one to study system-wide properties in molecular terms. We are developing novel, generalized knowledge representation schemes for the study of the very complex molecular systems of the living cells like the regulatory network of gene expression.

Research: Genome bioinformatics

The Bioinformatics Group has special expertise in large-scale bioinformatics data management systems that have become an integrating force in systems biology, by providing common platforms and databases for different high-throughput experimental technologies. In recent years high throughput transcriptomics and the DNA structures responsible for gene expression regulation became the major focus point of our scientific interest. The expression of genetic information is a highly organized process, mainly controlled by DNA binding regulatory proteins. These proteins bind to particular pattern forming short DNA segments, which traditionally are investigated *in silico* by using the conventional nucleotide based description of the DNA. However in this conventional DNA representation many important features of the DNA are included only in an implicit manner. We have worked out a novel DNA representation strategy using a wide range of chemical, physical and conformational DNA parameters which reflects the molecular structures responsible for sequence specific DNA-protein interaction in a more direct and more intuitive manner. We have developed DNA Readout Viewer (DRV) a dedicated software system that displays DNA by using this new data representation, and exhibits the structural and functional features of DNA from a very novel point of view. This online visualization tool is freely available for the research community (https://drv.brc.hu/). The scientific data booming trends also reached the field of gene regulation and DNA protein interactions research. The massive amount of data generated by the specialized high

throughput technologies like ChIP-Seq, HT-SELEX, and PBM could inform us about important hidden functional patterns and relationships. However, recognition of them far exceeds the human cognitive capacity, and not even the traditional bioinformatics algorithms can perfectly cope with these problems. To address this issue, in our current research we combine the above mentioned novel DNA representation method with different deep learning based datamining approaches for deciphering hidden DNA patterns in the bulk data produced by high throughput genomics investigations.

Bioinformatics Services

Most biologists today need some kind of assistance in analyzing the data gained from high-throughput investigations and in keeping up with the new bioinformatics analysis methods. Bioinformatics Group as the member of the Core Facilities of BRC offers bioinformatics consulting services for BRC researchers, participates in solving the arising bioinformatics problems, and provides custom bioinformatics software solutions. Most of these support activities are done in a cooperative manner which resulted in an extended scientific collaborative network around the group over the years. Identification of cardiovascular disease causing mutations, investigation of signal transduction gene families, studying plant-bacteria symbiosis and the analysis of CRISPR/Cas9 genome editing technologies should be mentioned — without aiming to give an exhaustive list — as the topics of our most important collaborative projects.

Our group played a key role in establishing the biocomputing infrastructure of the institute. We have developed BRC BioNet, an HTTP-based intranet resource, which is accessible from any of the over four hundred PCs and workstations in the laboratories. BRC BioNet's tools include:

- Library information and online access to scientific journals
- Institutional citation database
- Scientific Toolbox: hundreds of pages with useful practical information for researchers like periodic table, fact sheets about isotopes, vectors, restriction sites, etc.
- A collection of more than a thousand WWW links of biological interest