

The Bioinformatics Research Centre

University of Edinburgh

The Edinburgh Centre for Bioinformatics provides support to ground level initiatives in the Bioinformatics and Systems Biology fields, integrates teaching-related activities across the University of Edinburgh, provides databases and software tools and leads multicentre, interdisciplinary projects.

Edinburgh has one of the largest and best groups of researchers with interests in bioinformatics in the UK. The network and collaborations that underpin the Edinburgh Centre for Bioinformatics (ECB) draw on several highly-rated academic Schools within the University of Edinburgh, on other Universities and on world-leading biological and biomedical Research Institutes in and around the city. The importance of bioinformatics at the University of Edinburgh is reflected in the level of investment in new infrastructure. The new £40M Informatics Forum building, currently nearing completion, will host a life sciences wing with wet lab facilities that will stimulate interaction along the Informatics/Life science interface. The £6M C. H. Waddington Building will house the Centre for Systems Biology, bringing together researchers from a broad spectrum of disciplines. The Edinburgh Centre for Bioinformatics plays a key role in linking well established disciplines, such as life scientists, computer scientists and other physical scientists, in order to further stimulate Edinburgh's multi-disciplinary approach to bioinformatics. Its aim is to ensure that bioinformatics is a research discipline that drives biological research, and some of the key areas it is involved in are described below.

Modelling systems

The current progress in "omics" technologies is leading to vast quantities of information that researchers will need to analyse in order to obtain a better understanding of biological phenomena. New data are also being generated at different biological levels—for example, at the phenotype, intramolecular, and intercellular levels.

Modelling systems are being developed in order to effectively analyse the data being generated, but there is little standardisation between systems, making it difficult to share information. Researchers at the Edinburgh Centre for Bioinformatics aim to overcome these difficulties by developing a modelling system that is fully standardised and can be used by biologists, utilising SBML (Systems Biology Markup Language). The Edinburgh Pathway Editor (EPE) has been developed as a modelling system that will provide the scientific community with the necessary computational aid to manage biological data and perform comparative analyses between such data.

Pathway maps provide a means to organize multidimensional views of a wealth of information and a means to assemble known and novel network characteristics. EPE is a first step toward the new generation of systems biology software that will provide a seamless, transparent front-end interface for theoreticians and experimentalists alike.

"Pathway generation and analysis has the potential to lead to novel pathway biomarkers, predict possible drug adverse effects, and ultimately reduce the time required for drug development."



Human metabolic network

Ongoing work at the Edinburgh Centre for Bioinformatics focuses on human metabolic network reconstruction. Many human diseases are caused by, or result in, an abnormal metabolic state. A better understanding of human metabolism and its relationship with diseases is therefore an important task in human systems biology studies. For an in-depth understanding of the large amounts of data generated from metabolomics, a complete and high-quality human metabolic network is essential. This type of network links various metabolites by enzyme catalyzed reactions and allows us to discover the genetic mechanism which causes the abnormal state of metabolites, by network analysis and further kinetic modelling. Using this information, drugs which could target so far uncharacterised genes/proteins can be developed for disease treatment.

Biosimulation

The formulation of quantitative models of normal and dysfunctional biological systems helps to provide the basis for a disease-driven drug development process, which can lead to biologically designed medicines. Biosimulation models at the Edinburgh Centre for Bioinformatics are focused on the application of computer simulations to a number of concrete problems for the acceleration of drug discovery and to contribute to the formulation of standards for the use of simulation models in the drug development process. The group is their close collaborative links with active experimentalists. Indeed, the team is an exemplar of the kind of modelling work that can be undertaken in an environment which closely integrates computing and biology. They take well tried and productive techniques from different areas — e.g. modelling of concurrent systems, machine learning — and apply these to modelling biological systems.

Bio-energy

Much focus has been placed on the role of bioinformatics in biomedical science, but bioinformaticians in Edinburgh are also involved in another key area, that of energy. Researchers are looking into ways of using pathway modelling to improve sources of bio-energy. By reconstructing pathways, scientists can predict the genetic modifications required to make more efficient energy generating organisms. These could become a potentially valuable new resource for the generation of sustainable energy.

Vision for the Future

The Edinburgh Centre for Bioinformatics will continue to play a vital role in coordinating multi-centre and interdisciplinary collaborations that will attract global talent and drive bioinformatics research forward. Its far-reaching network can identify new areas where bioinformatics can solve researchers' problems, both in academia and in industry. Innovations such as the Edinburgh Pathway Editor will ensure that bioinformatics techniques are accessible to all and will continue to enhance all areas of life sciences research. Specialised expertise in metabolic networks and biosimulation models will speed the development of new drugs by improving drug design prediction, in areas such as personalised medicine.

“The Edinburgh Centre for Bioinformatics has created a multi-disciplinary research environment that brings together world-class biology and world-class informatics. It will have a positive effect on science and society in the years ahead.”

About The Scottish Bioinformatics Forum

The Scottish Bioinformatics Forum (SBF) was created for all developers and users of bioinformatics methods, and supports both the academic research base and commercial organisations by actively promoting training and facilitating access to bioinformatics skills. It is funded by the Scottish Executive, the Scottish Funding Council, and Scottish Enterprise.

www.sbforum.org

