

The Bioinformatics Research Centre

University of Glasgow

The Bioinformatics Research Centre at the University of Glasgow provides an exceptional environment for collaborative interdisciplinary research in Bioinformatics.

The Bioinformatics Research Centre (BRC) is part of the Department of Computing Science, but is located in laboratories in the Faculty of Biomedical and Life Sciences. The physical location of the centre reflects the strongly collaborative and interdisciplinary nature of its research programme, which aims to close the loop between the wet-lab and in-silico analysis, actively promoting joint projects between life scientists and bioinformaticians. Current research activities in the Centre range over a wide spectrum of application areas in the biomedical and life sciences, and employ a wide range of techniques from computing science, reflecting the richness of research in life sciences and computing at Glasgow. The focus is on modelling biological systems and structural biology. Research into related computational techniques includes machine learning, eScience and Grid, visualisation and databases for bio-data. The Centre is directed by Professor David Gilbert, and has a rapidly expanding strong and active research team with backgrounds including molecular biology, computer science, mathematics, statistics and engineering. The Centre plays an active role in Bioinformatics at both the national and international level.

Unique strengths

The close working relationship between the computational scientists and the biomedical and life sciences researchers is what places the Centre at the forefront of bioinformatics research. The Centre's team includes both dry and wet researchers; the wet researchers from the CBR work in biological laboratories, alongside colleagues from the Faculty of Biomedical and Life Sciences. Computers are actually located in the wet labs, so creating a truly integrated research group. The result of this approach is an interactive loop between the modellers and the experimentalists, so that models can be validated by wet lab data, and at the same time modelling/analysis can be used as a basis to prune the experimental search space. The long term strategic goal is to develop methods for faithful and predictive modelling of biochemical networks; in other words closing the gap between the wet and the dry laboratory.

The Centre facilitates this wet-dry interaction by translating between mathematical formalisms and traditional biological conventions, in particular in the area of system model generation, model evaluation and modelling with incomplete or semiquantitative knowledge. It plans to transfer these technologies to develop intuitive analytical tools that efficiently address the challenges faced by experimental scientists in areas such as metabolomics, or proteomics and cell signalling.



Core skills

The Bioinformatics Research Centre has well established research activities in computational techniques such as machine learning and induction, graph algorithms, probabilistic models, stochastic process algebra and concurrency, ODE modelling and constraint-based reasoning. In addition they have well established experience of applications such as signalling pathways, metabolic networks, microarray data, semiquantitative data, protein structure.

Work is distinctive in ways including: use of process algebra to model signalling pathways, development of machine learning techniques to integrate information from heterogeneous sources in order to improve predictive analysis, inference and analysis of gene networks, the development of reasoning techniques based on the viewpoint of life scientists.

“We see our Centre as a test-bed for the future of life sciences research.”

Focus on Systems Biology

Bioinformatics has traditionally been understood to be the application of computer science, mathematics and statistics to the analysis and understanding of biological data. While analysis has often been on the composition and function of individual components such as a gene and its products (RNA, protein), the cutting edge of research in bioinformatics focuses on the understanding of behaviour of biological processes as systems instead of as isolated parts — thus on analysing the relationship and interactions between individual components of systems. In this respect there is an important overlap between bioinformatics and systems biology, and research at the BRC is placed firmly in this space.

A systems approach by its very nature requires close interaction between life scientists, computer scientists, mathematicians, statisticians and engineers. The Centre’s team includes researchers from all these backgrounds. A unique point about 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.

Vision for the future

The Centre’s ambition is to move from explanatory modelling to predictive modelling, thus making significant progress in the modelling field. It aims to be able to predict the effects of modifications to known networks as well as to modify network models in order to conform to some external description of the network, based on logical properties. The applications of this approach are important and could have a wide effect; for example many drugs are developed on a ‘trial and error’ basis, and drug design driven by predictions of the behaviour derived from robust modelling techniques is a very important issue for pharmaceutical companies and the health industry in general.

“People come to us because of our computational biology credentials and our innovative approach that bridges the gap between wet-lab and in-silico analysis”

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.

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