

Introduction

## Highlights from the 5<sup>th</sup> International Society for Computational Biology Student Council Symposium at the 17<sup>th</sup> Annual International Conference on Intelligent Systems for Molecular Biology and the 8<sup>th</sup> European Conference on Computational Biology

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### Abstract

This meeting report gives an overview of the keynote lectures and a selection of the student presentations at the 5<sup>th</sup> International Society for Computational Biology Student Council Symposium at the 17<sup>th</sup> Annual International Conference on Intelligent Systems for Molecular Biology (ISMB) and the 8<sup>th</sup> European Conference on Computational Biology (ECCB). The symposium was held in Stockholm, Sweden from June 27 to July 2, 2009. We also report on other Student Council events that were organized at ISMB/ECCB 2009.

### Introduction

The Student Council (SC) of the International Society for Computational Biology (ISCB) is a world-spanning organization for students in the broad field of computational biology and bioinformatics.

The major aims of the Student Council are to organize events and facilitate networking opportunities for students. The main contribution of the SC is to nurture soft skills, such as working in a team, organizational and net-

working skills, to complement the normal academic program. Since its inception, the Student Council has organized an annual student symposium for the benefit of the student community. This year the fifth Student Council Symposium was held in conjunction with the joint ISMB and ECCB conferences on June 27<sup>th</sup>. Over 120 delegates took part in this first anniversary edition of the Student Council Symposium. The symposium featured three keynote lectures, a research partner session with two speakers, a tutorial, a panel discussion, nine student presentations and a poster session.

This year's keynotes were delivered by three very well-established and acclaimed scientists. The symposium started with a keynote lecture by Peer Bork (EMBL Heidelberg, Germany) on the topic of "Integration of heterogeneous data in Biology: from chemicals to ecosystems". The afternoon session was initiated by Michal Linial (The Hebrew University of Jerusalem, Jerusalem, Israel) with a presentation titled "In search of overlooked functions: hidden connections among proteins, toxins and viruses". The day was concluded by Overton Prize winner Trey

Ideker (UC San Diego School of Medicine, USA) with his presentation "Biological Networks: Facebook for Proteins".

In the research partner session we were fortunate to have two presenters that delivered highly interesting scientific lectures. First, Barend Mons (Netherlands Bioinformatics Centre) gave an overview of the initiatives and tools developed at NBIC to optimize the value added to bioinformatics research. Next was Jong Bhak (Korea Bioinformation Centre), who gave an account of the first sequenced genome of a Korean individual, and showed that this provides unique insights in this socio-ethnic group.

New this year was a tutorial session. Keeping in mind the increasing need of statistical analysis and data mining in bioinformatics, we selected a topic of broad interest: R/Bioconductor. The tutorial was given by Wolfgang Huber (EMBL Heidelberg, Germany), one of the core members of the Bioconductor project, who gave valuable insights into this very important topic.

The theme of our panel discussion this year was "Bioinformatics in the era of personal genomics". We invited three panelists from academia and industry to talk about their experiences and discuss questions from the audience. The discussion was moderated by Jeroen de Ridder. This year's panelists were Michael Brudno (University of Toronto, Canada), Subhajyoti De (University of Cambridge, United Kingdom) and Dirk Evers (Illumina, United Kingdom). The discussion was highly interactive and many of the delegates participated actively.

## Proceedings

Eight students had the opportunity to present their work orally, while 64 students accepted the opportunity to show their accomplishments during the poster session. For the meeting report we selected the best abstracts from the 101 submissions. This comprises seven abstracts from the oral presentations and seven abstracts from the best-ranked poster presentations. The review procedure, supervised by the Program Chair Thomas Abeel, was conducted by an international group of more than 40 students and young researchers.

The fourteen abstracts can be grouped in four very broad categories: (i) functional genomics and gene expression, (ii) protein structure and function, (iii) evolution and population biology and (iv) next-generation sequencing analysis and applications.

### 1. Functional genomics and gene expression

Genome-wide sequencing has undoubtedly revolutionized the way we do biology. Nowadays, thousands of complete genomes are available, and many more will be

available within the next decade. The challenges of genome assembly and annotation have largely been conquered. However, the functional output of those genomes is not yet completely understood, and is currently the focus of research. One of those functional outputs is gene expression, which is the first step towards the generation of a phenotype. During the symposium several studies have taken advantage of the capabilities of genome-wide expression technologies and the availability of such data that has been accumulated in the past decade to answer relevant biological questions. For example, Szczepińska et al. [1] use gene expression data to explore relations between gene expression and genomic context. They identify and functionally annotate distant genomic clusters within co-expression clusters. The number of annotated clusters was significantly higher than random. Koeva et al. [2] combine shared differential expression with homology to define "core stemness mechanisms" in mouse stem cell types. Co-expression analysis has become an essential part of the data exploration phase when dealing with genome-wide expression data. Although several algorithms are available for this purpose, new and more efficient ones are constantly being developed. One new algorithm, designed by Schulteiss et al. [3], uses a newly developed SVN-kernel to identify regulatory modules. Exploring functional aspects of the genome does not need to involve generating new data, since a vast amount of data is publicly available. This allows us to search for sets of related experiments with biological relevance. Caldas et al. [4] describe an algorithm to query the data based on the actual measurements instead of the textual annotations. Such a huge amount of data requires specialized visualization to be interpretable. Standard heat maps and profile plots cannot handle hundreds of thousands of samples. This is where Space Maps come in, a visualization technique developed by Gehlenborg et al. [5]. Expressed genes are by no means the only functional output of genomes. The role of non-coding RNAs in the regulation of cell processes cannot be ignored. Moreover, their function can actually be used to uncover the functions of genes, by using high-throughput siRNA screens. These screens can identify genes that underlie similar phenotypes by the clustering of their screen profiles. Samusik et al. [6] describe how genes that show the same phenotypes are more likely to interact with each other and they developed a method of cross-validation of siRNA screening data using protein-protein interactions.

### 2. Protein structure and function

Proteins are the building blocks of life. Ultimately, the expression of genes leads to the expression of proteins. However, computationally speaking, proteins are much more complex than DNA, since their function is extremely dependent on its tridimensional structure, which varies from protein to protein.

Predicting how a protein will fold from its linear sequence of amino acids is in itself a complex problem and it is even more challenging for transmembrane proteins. Tran et al. [7] implemented a new algorithm that can successfully deal with super-secondary structures in beta-barrel transmembrane proteins. Once folds and structures have been determined, structural alignment allows extending them to closely related homologs. Although several methods exist today to achieve such a task, they are mostly heuristic. Wohlers et al. [8] developed PAUL, a non-heuristic approach that can outperform existing methods. There are several factors that influence variability in structural alignments. Pirovano et al. [9] determined that certain types of folds (helices and coils) are usually observed in inconsistent alignment regions. Since this observation is at odds with currently used alignment strategies, more care should be taken in the development of new algorithms. Protein structures, more than the sequences themselves, capture the function of a protein. Hence, they are better suited to identify functional homologs. Combining structure searches with advanced HMMs is a much more reliable way to search for conserved functions than simple sequence similarity searches. Petrossian et al. [10] uses this strategy to predict novel methyltransferases that are also shown to bind the appropriate substrate.

### 3. Evolution and population biology

If proteins determine phenotype, evolution determines which of those phenotypes we are likely to see by natural selection. Selection itself depends on diversity. Functional divergence or selection for new function is the hallmark of successful adaptation. Hence, the identification of proteins under functional divergence is of broad interest. Williams et al. [11] present a fast new method for detecting these changes on the whole-genome level across a complex phylogenetic tree. They also apply the method successfully to the evolution of pathogenicity in divergent bacterial lineages. The diversity that selection operates on can also be the source of disease susceptibility among individuals. Genome-wide association studies aim to find the association between genetic markers, usually SNPs, and disease. Lee et al. [12] address the challenge of selecting representative SNPs for supporting a disease-gene association. They demonstrate superior performance when using a Pareto optimality based approach.

### 4. Next-generation sequencing analysis and applications

Next-generation sequencing technology is enabling massive production of high-quality data with a variety of applications. It will undoubtedly revolutionize the limits of what is possible and affordable in experimental biology. Applications of next-generation sequencing include de novo sequencing, re-sequencing and sequencing of RNAs for applications formerly limited to microarrays. Many platforms (Illumina Genome Analyzer, Applied

Biosystems SOLiD, Helicos HeliScope) are currently able to produce "ultra-short" paired reads of lengths starting at 25 nt. It is still an open question whether genome re-sequencing is feasible with ultra-short paired reads. Chikhi et al. [13] show that re-sequencing requires significantly (48.3%) shorter paired reads to produce results comparable to unpaired reads. High-throughput sequencing technologies open exciting new approaches to transcriptome profiling (RNA-Seq). Bohnert et al. [14] developed a new technique to accurately infer the underlying transcript abundances based on linear programming, which is also a powerful tool to reveal and quantify novel (alternative) transcripts.

### Conclusion

In total we received 101 abstract submissions. Each abstract was rigorously reviewed by at least 3 reviewers. From the 101 abstracts, we could only select 8 for oral presentation, due to time limitations on the program. One abstract was rejected and the authors of the remaining 92 abstracts were invited to present their poster, which 64 of them accepted. The presented research covers a broad range of topics including microarrays, proteomics, genetics and genomics. Fourteen outstanding abstracts have been selected to compile this supplement.

Thanks to our generous sponsors, we were able to hand out nine travel fellowships to help cover expenses for students to attend ISMB/ECCB and the Student Council Symposium. Two of the travel fellowships were given to excellent students from developing nations to give them the opportunity to present their work and to meet potential collaborators.

A new initiative introduced this year was the Student Council Career Central (SCCC) in form of a lounge in the exhibit area and seminars. This initiative is an endeavor by the Student Council to address the needs of recruiters and job seekers in the field of computational biology. SCCC provides a platform for research institutes and companies to attract some of the best talents in computational biology from the Student Council community and attendees at ISCB conferences all over the world. During the ISMB/ECCB 2009 conference SCCC offered one-on-one resume critique sessions sponsored by FASEB with Dr. Clifford S. Mintz, who helped students to improve their CVs and resumes. Seminars about various career options available at the European Bioinformatics Institute and non-academic career paths were also offered as a part of SCCC this year.

### The future

The 6<sup>th</sup> Student Council Symposium will be held in Boston, MA, USA in conjunction with ISMB 2010 in July 2010. Further information about the Student Council and

the events we organize is available on our website: <http://www.iscbsc.org>.

### Competing Interests

The authors declare that they have no competing interests.

### Authors contribution

TA, JdR and LP drafted the manuscript.

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