

# The computer as a laboratory

Jan Komorowski, a professor of bioinformatics at the Department of Cell and Molecular Biology at Uppsala University, describes himself as a strange bird. Unlike most of his departmental colleagues, his degrees are in computer science.

Following undergraduate studies in computer science at Warsaw University and a PhD at Linköping University, Jan Komorowski started out as a young professor in computer science at Harvard University. He soon became interested in a biomedical approach to problems, and took up a job at Harvard Medical School. Eventually, he got into bioinformatics and researching learning systems in the life sciences, i.e. systems that can learn to classify huge quantities of biomedical data.

“We can use learning systems to establish which combinations of mutations in a virus make it highly pathogenic, for example, or what environmental factors alongside a genetic predisposition contribute to the development of allergies,” says Jan Komorowski.

One of their discoveries is that a child is unlikely to become allergic to animal fur if born to a woman living in the countryside and in constant contact with animal fur during pregnancy.

“Large parts of the life sciences have already become information sciences, so the researchers in those fields have to master quantitative methods in much the same way as do physicists and chemists.

The challenge is to understand and develop not only what underlies the computation methods and mechanisms, but also the biological principles and phenomena,” according to Jan Komorowski.

He says they do not always realize they have struck gold, and may need help with interpretation. Sometimes it is the other way round, with the biologists needing guidance on data analysis.

Interdisciplinary cooperation is the best solution. Throughout his time at Uppsala, Jan Komorowski has enjoyed a very fruitful interdisciplinary cooperation with Claes Wadelius, professor at the Department of Immunology, Genetics and Pathology, Uppsala University.

Computer technology also facilitates international cooperation. Expertise in bioinformatics is in short supply, and Jan Komorowski is also involved in activities such as a worldwide research project being run within the International Cancer Genome Consortium (ICGC).

“This development creates obvious problems in the training of future bioinformaticians and biologists. Ideally, we would like to see both sides equally double-skilled, which is of course very difficult to achieve. They will work out a successful solution eventually,” he believes.

Biology is making huge contributions to computer science. Jan Komorowski describes fascinating developments in genetic and ant algorithms, DNA calculations and the whole artificial intelligence field, where development is being inspired by nature’s solutions. This is stimulating mathematics and computer science to develop methods for handling large quantities of uncertain data.

“We and biologists often have different ways of looking at problems. But when we are able to combine our knowledge, it really is something special, enabling us to create exciting new models for biomedical research. We are the right people, in the right place, at the right time. As computer scientists, it is incredibly exciting to be contributing to research results published in the biomedical literature,” he says.

Among other things, they are studying the regulatory mechanisms behind common diseases such as type II diabetes, and various common types of cancer, for example cervical, stomach, intestinal and pancreatic cancer. The technical developments that have totally exploded in recent years have generated huge quantities of data. Making tools suitable for all the data that modern biology generates is an important task for the research team.

The challenge is to understand the biological systems sufficiently well. For the last fifteen years, he has been involved with and has led the Linnaeus Centre for Bioinformatics in Uppsala. Today, he has dual profes-

sorships at Uppsala University and the Polish Academy of Sciences in Warsaw. Many techniques that he uses in his day-to-day work stem from research in artificial intelligence. They are reaping a fantastic harvest at the moment, he says.

“You frequently get a different perspective and a clearer picture by looking at biological problems through computer science eyes,” says Jan Komorowski.

His research group in Uppsala consists of seven people, all from different countries across the globe. It is a stimulating, international environment.

He also mentions that his time as a young professor in the USA was very important. What he learnt there has benefited him throughout his research career. For example, not to attempt interdisciplinary research when you have not made a significant contribution to either of the research fields concerned. On the contrary: you need to reach a high level in one field before embarking on another.

He remembers growing up as a youngster in Poland under the repressive Soviet-controlled system. Escaping through knowledge was one of the ways of giving life meaning beyond everyday concerns.

He met a professor of the history of science regularly, learning about research and research methodology during their walks together.

“These walks were perhaps similar to how they learnt in the gymnasium in ancient Greece. I understood only later how important they were,” says Jan Komorowski, and highlights his supervisor Erik Sandewall as an important role model.

Besides research, he is very interested in sailing and skiing. He has found time to complete five Round Gotland offshore sailing races and two Vasaloppet long-distance cross-country ski races. And hanging on a wall at home is a gold medal for giant slalom from the Polish University Championships. There are the five children at home, too, he adds with a smile.

