→ Portraits
Bioinformatics network
introduces itself

→ Augmented reality
What’s behind the faces?
Special issue focused on the presentation of the Dutch bioinformatics community and the embedding of NBIC as partner in the Dutch Techcentre for Life Sciences (DTL).

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Ready for the future

Bringing skilled people together is the crucial factor in getting bioinformatics going. That is exactly what NBIC has been working on since its start. NBIC expert groups typically operate at the interface of skills, as bioinformatics is the field where biology, medicine, computer science, statistics and biochemistry come together. NBIC has been successful in connecting these disciplines across sectors, and across institutions in the Netherlands. In less than 10 years, over 100 young bioinformaticians have received high-level training in NBIC projects and courses, capitalising on a well-connected expert community. In this magazine special – InterfACES – we are proud to present the diversity of the NBIC bioinformatics community as the fundament of the bioinformatics future in the Netherlands. These skilled specialists drive life science approaches, in which big data handling and dtl will offer a federated platform for next generation bioinformatics without making all the mistakes others made before. You have the potential to hop. The NBIC programme is marvellous. The Dutch are very open to novelties. What would be really good, though, is to encourage people to open up their technologies, their datasets and their tools. Scientists really ought to behave like good citizens, who not only take from the community, but also give back.

Bioinformatics requires government support

"Bioinformatics is crucial. No discussion. Today, life scientists need advanced computing and software tools to manage the overwhelming dataflow. The question is how to organize an effective infrastructure and, at least as important, a high-quality research and education facility. In my opinion our government has a vital role to play in sustaining the strong Dutch bioinformatics position built up in the NBIC community. One would have to invest in compute infrastructure and bioinformatics education just like the authorities in our neighbouring countries. NBIC's approach, that is now embedded in DTL and in the NBIC Research School, deserves to be strongly supported by our government."

The Dutch are very open to novelties

Carole Goble
Manchester University, NBIC International Advisory Committee

Computer scientist Carole Goble said about the Dutch approach: "You may have been a slow starter, but that allowed you to jump into bioinformatics without making all the mistakes made before. You have the potential to hop. The NBIC programme is marvellous. The Dutch are very open to novelties. What would be really good, though, is to encourage people to open up their technologies, their datasets and their tools. Scientists really ought to behave like good citizens, who not only take from the community, but also give back."

Mid Term Review Committee (2011)

"The coordinated effort realized by NBIC at building a computational biology and bioinformatics faculty has resulted in an impressive accomplishment. NBIC helps in turning data into knowledge and is a catalyst for changing concepts into practice. The assessment committee would be very disappointed if NBIC would not be able to continue its activities in the future."

In dire need of continuation

"When I joined the NBIC Supervisory Board I was impressed by the bioinformatics network in our country. This strong body of expertise is still growing and has acquired an international reputation. Maintenance is required to keep up this position. It would be a shame if our well organized bioinformatics network disappeared due to lack of funding. In fact, the life sciences cannot afford this loss. Nowadays, life sciences urgently need bioinformatic support to process, store and analyze the huge omics-data flows. I therefore welcome the DTL-DISC initiative, which will guarantee the continuation of our strong position in the field of bioinformatics."

Bioinformatics is a must

"In the past decade bioinformatics has achieved a solid position in the life sciences. It has become an integrated part of biology, needed by every biologist or life scientist and embedded in academic research and industrial environment. We have succeeded in building a strong network in the Netherlands. The big challenge now is to keep the community up and running after financial funding comes to an end next year. A central platform will be necessary to fuel cooperation and to stimulate interactions between the individual members of the community. I think NBIC’s initiative of the NBIC Research School fulfils that need. The importance of bioinformatics cannot be emphasized enough!"

Board of Directors

From left: Barend Kooi, Ruben Kok, Jaap Heringa, Marcel Reinders

KAREL LYUBEN
Rector Magnificus of the Delft University of Technology, Chairman NBIC Supervisory Board

The coordinated effort realized by NBIC at building a computational biology and bioinformatics faculty has resulted in an impressive accomplishment. NBIC helps in turning data into knowledge and is a catalyst for changing concepts into practice. The assessment committee would be very disappointed if NBIC would not be able to continue its activities in the future.”
Bioinformatics students are finding their way. Activities are well attended by the various student groups (PhD, MSc and BSc). PhDs often join the Regional Student Group (RSG, Netherlands).

When NBIC was started in 2003 to stimulate the bioinformatics field, there was basically no field to speak of at all. Just a few scattered groups were engaging in bioinformatics research at that time. NBIC brought parties and activities together, to set the development track in motion and to employ the right communication channels. In the first years, the efforts focused on involving bioinformatics experts and students in a broader collaborative network. Gradually, the small and immature field of bioinformatics was transformed into a strong bioinformatics community.

Today, the NBIC faculty members comprise an extensive and vibrant network of researchers from academia and industry. Their joint efforts advance the bioinformatics field and boost research in biology and medicine. Knowledge transfer and training are the main issues. The community output takes many different forms varying from research findings and educational material to computational methods, prototypes of software and databases and, perhaps most importantly, human capital. Maintaining this bioinformatics network and educating the next generations of bioinformaticians are very important elements of the NBIC Research School in bioinformatics and computational biology, as partner in DTL.

On the next pages eight members of the NBIC network will explain their research and their contributions to the bioinformatics community. Their portraits clearly illustrate that the present bioinformatics network provides the perfect platform for sustaining and further developing the Dutch bioinformatics field.

Students
Roeland van Ham  
Bioinformatics and Modelling  
Keygene, Wageningen

Towards a green gene revolution

“One of our main research goals is to determine the genetic basis of plant traits and to develop methods to introduce those traits into crops. Our passion is a green gene revolution, which means that we employ smart strategies as alternatives to genetic modification. Bioinformatically, we focus on new tools to determine which genes are connected to a certain trait and tools to optimize the plant breeding process. To me, the most appealing challenge is to be able to determine right down to the level of an individual DNA base if, how and to what extent this base contributes to a given trait. If we are able to do that, we can really start molecular engineering on a whole new level.”

Chris Evelo  
Department of Bioinformatics – BiGCaT  
Maastricht University

Understanding what we don’t know by using what we do know

“Our research theme is turning experimental data into biology through data integration and combination with existing knowledge, which we collect for instance on WikiPathways. From this perspective, I see two main challenges in bioinformatics. The first is the need to understand more about the effects of genetic variation and to integrate variation into systems biology approaches. The second is that the time has come to make the semantic web work on real problems. That won’t be easy, because it requires much detail in knowledge and we need to make a lot of implicit knowledge explicit. A major hurdle here is the difficult communication between the people who build the semantic web and the biologists who need to provide the knowledge.”

Joost Kok  
Leiden Institute for Advanced Computer Science  
Leiden University

Discipline-based thinking will fade away

“Although we are not exclusively linked to life sciences research, our main focus is on biological data. We participate in several large-scale European research projects. In the Netherlands, we get involved in the Dutch bioinformatics community through NBIC. Right now, biology is primarily seen as an application area by informaticians, but I think that we will see a growing integration of these disciplines. In general, discipline-based thinking will fade away and we will move towards a network-based structure in which we will perform our research. The NBIC Research School is an example of how the problem domains and the technology domains can come together in a new environment.”

Jildau Bouwman  
Bioinformatics group  
Microbiology and Systems Biology, TNO

Facilitating big data research programmes

“The overall theme we work on is healthy living. The systems biologists in our research group concentrate on nutrition and toxicology resolving questions in these fields in a holistic manner. As bioinformaticians, we facilitate big data research programmes and our primary focus is on data interpretation (e.g. with network analysis). We are also involved in several European projects, in which we act as a kind of ‘data broker’. We position ourselves between the biologists on one side and the hardcore bioinformatics researchers on the other, by performing data management activities, such as designing and building suitable databases. In this respect DTL-DISC, as an interdisciplinary group, provides an excellent environment to bring both parties together.”
Stimulate people to realize their full potential

“Bioinformatics has developed perfect methods for combining and integrating data and recognizing certain patterns, but what is missing is an ability to come up with good mechanistic, quantitative models. We think we have a good view of how a system works, but once you start to describe it in a mathematical model you realize what you don’t know yet. There is still a large gap between data analysis and quantitative modelling. To me, it is a great challenge to stimulate my group to find answers to the research question how things actually work. By provoking research ideas and calling on critical feedback, people are encouraged to realize their full potential. To link people to each other, make sure they interact and collaborate.”

Urgently need to get a really multidisciplinary approach

“Our work spans applied bioinformatics, experimental biology, and genomics technology. Our collaborations are also very diverse. We collaborate with bioinformatics groups, including structural and systems biology groups, medical experts in the clinic, like geneticists and oncologists, and other technology centres, like the Netherlands Proteomics Centre. If we manage to bring all the different fields together, I see a lot of opportunities for making a difference for both fundamental and clinical research. Therefore, it is urgently needed to get a really multidisciplinary approach. Furthermore, it is important to recognize the opportunities of the day after tomorrow and to translate those into a clear vision and strategy. In my opinion, bioinformaticians are too often swayed by the issues of the day.”

Prediction remains a challenge

“The two main themes in my group are diagnostic classifiers for better stratification of cancer patients and unravelling the molecular mechanisms that determine outcome and therapy response. Right now, diagnostic classifiers are black boxes, but we want to understand the underlying mechanisms. If we better understand how genes and pathways interact, we can hopefully better predict which therapy is the best option for a certain patient. A main challenge is being able to generate good quantitative, predictive and interpretable models. With that I mean models that can be used to accurately predict an outcome in a system that was not used to generate the model and consequently use the model to further our understanding of the underlying molecular mechanisms.”

Getting a grip on data

“Our core activity is finding bioinformatics answers to research questions in biology or medicine. About half the group is working on large-scale calculations and here the key is to deal with the ever-increasing data streams. How do we collect, store, filter and process all this data? The other half concentrates on making data accessible for the research community, for example by collecting datasets that physicians and researchers have stored on their own computers and bringing it all together in a database. A major challenge right now is to ensure that scientific results are disseminated in a transparent manner. Publishing analysis results is one thing, but to really assess the quality of those results you need insight into the protocols used. We need tools that can retrieve those protocols.”

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Bioinformatics Network

Facts & Faces

Interesting people, joint activities and lively events

Founding Fathers

In 1999, Gert Vriend (left) accepted the task of establishing a national Dutch bioinformatics centre. Bob Hertzberger was asked to assist and was appointed as the first scientific director of NBIC in 2001. Their efforts have led to today’s bioinformatics network in the Netherlands.

LOBIN

Martijn van der Bruggen of the Hogeschool Arnhem-Nijmegen is secretary of LOBIN, the network of bachelor bioinformatics programmes at Dutch Universities of Applied Sciences (UAS, in Dutch HBO). LOBIN activities include the exchange of curriculum information, collaborative promotion of bioinformatics among students, teacher training sessions and a Career Day.

NBIC conference

The yearly Netherlands Bioinformatics Conference is the place to meet the bioinformatics network in the Netherlands. In 2012 more than 300 participants visited the conference.

BIuP

As a private sector initiative, the Bioinformatics Industry Platform (BIuP) has been set up in a close link to NBIC. Companies discuss bioinformatics expertise and software tools they use in research and product development.

Antoine van Kampen

Scientific director of NBIC from 2006 until 2009. He then stated: “NBIC and its consortium members play an essential role in establishing bioinformatics in the Netherlands. Together we have been able to build a vibrant and well-organized bioinformatics community found in few other countries.”

NBIC PhD school

Dick de Ridder has been course coordinator and teacher in the NBIC PhD School from the beginning. The school offers a comprehensive programme of advanced courses, all being developed in close collaboration with the bioinformatics community and taught by leading experts in the field.

NBIC consortium

The NBIC consortium in 2013 includes 10 universities, 8 university medical centres, 9 institutes and 9 organizations from industry.

Careers

Bioinformaticians spread their wings and start a promising career after their NBIC training and education. They go to work in research or industrial environments, at home or abroad.

Richard Notebaart, Group Leader Systems Biology, EMBL, UMC St Radboud, Nijmegen

Ingo Wassink, Researcher & Software Architect at Nedap Agri, Brielle

Walter Pirovano, Product Specialist Bioinformatics, BaseClear, Leiden

Wouter Meuleman, Postdoctoral Associate, MIT, Cambridge (USA)

Wouter Meulman, Postdoctoral Associate, MIT, Cambridge (USA)

Marcel Kempenaar, Lecturer and Researcher, Hanzehogeschool Groningen
Infrastructure & Engineering

Data generation in itself is no longer the road to scientific progress. Creating the right environment for the integration of data to extract knowledge is the key to tackling the complexity of biology. As part of its community-based bioinformatics programmes, NBIC has drawn particular attention to the development of a bioinformatics support programme for the expert handling and integration of biological datasets. It resulted in NBIC BioAssist as dedicated bioinformatics engineering and support environment. Here, data experts jointly develop and apply cutting-edge computational methods and tools, and make them accessible for life science research.

NBIC’s bioinformatics support approach strongly fuels the DTL programme for data integration and stewardship (DTL-DISC). DISC harbours the Dutch ‘node’ in ELIXIR, the pan-European research infrastructure project on biological information. Companies and academic groups, each bringing their own special experience, will work together in DISC to find the best way of dealing with data generated by new life science projects. Within DISC is a large diversity of expertise, ranging from hardware infrastructure and tools in the field of bioinformatics, medical informatics and e-science research to applied statistics and engineering.

On the next pages Jacob de Vlieg (Netherlands eScience Center) and Anwar Osseyran (SURFara) talk about their involvement in the DISC partnership. Then (p 16-17), Rob Hooft highlights the NBIC engineering team and its methods of working.

“eScience will become a fundamental discipline in all scientific research”

“For me the primary meaning of the ‘e’ in eScience is ‘enhanced’; eScience involves enhancing science by using ICT tools in all its manifestations. The meaning ‘electronic’ is only secondary. The role of the Netherlands eScience Center is to develop ICT tools to improve data driven science and thereby change the way to do research. Advances made in one discipline are often relevant to other research areas.”

“The main challenge in bioinformatics is to implement a cultural change with respect to the way we approach science and assess scientific efforts. Joining forces, as aimed by the current bioinformatics community, paves the way to progress. The dominant force is to come up with something new. However, there are already so many proven ICT & bioinformatics technologies out there that we want to focus our attention to using and implementing those first. This will ensure scientific, social and economical value. Basic research will always be necessary and essential but we don’t want to reinvent the wheel. We also want to explore existing informatics alternatives developed in different scientific domains.”

“I think that in ten years’ time eScience has become a fundamental element in all scientific research, underpinning all our work in the same way mathematics did in previous centuries. If you want proof of that, you only have to look at the rise of bioinformatics. Due to the human genome project and the molecular biology revolution in general, every modern biologist has become skilled in the use of bioinformatics and eScience.”

“A shared e-infrastructure is the future”

“We have learned a lot from our alliance with NBIC. To us, it is very insightful to collaborate with partners to employ in-depth usage of our technologies and facilities. We gained new perspectives on specific needs of the life sciences field. When it comes to Big Data, the three V’s are essential: Volume, Variety and Velocity. In life sciences, Big Data is about more than volume; this data is also characterized by an enormous variety in format and structure and differences in the rate at which data lose their value. Some types of data need to be stored for a long period, whereas other data quickly lose their value once used to determine a trend. An adequate e-infrastructure addresses all three V’s.”

“With DTL and DISC, an important step is made towards getting such an e-infrastructure for the life sciences off the ground. I would like to expand the activities of DTL even further towards setting up a sector cloud for the life sciences. A federative cloud that combines all the needs for storage, processing, sharing etc. This will be a distributed infrastructure where all parties within a sector can share data, but retain authority on who can access this data and for what purpose. This level of security and control will instil trust with the participants, which is the key factor into making it work. Such an approach is the way to go, because the future is in a shared e-infrastructure.”

Jacob de Vlieg
Scientific Director Netherlands eScience Center

Anwar Osseyran
Managing Director SURFara
Past decade NBIC developed a powerful organization, called BioAssist, providing bioinformatics support to researchers in the life sciences. Different groups working on similar bioinformatics problems collaborate in task forces to make sure that they cover their shared interest field without duplication. Over the years, five task forces have been in operation: sequencing, proteomics, metabolomics & nutrigenomics, biobanking and interoperability (i.e. making diverse data work together).

Each task force has a scientific leader, the primary investigator (PI), located at one of the collaborating academic groups, and a project leader (PL), a member of the BioAssist engineering team. While PIs identify common goals and give guidance on scientific content, PLs keep projects and people focused and give guidance on technical methods. The engineering team members work for the NBIC foundation. Programmers, stationed at different academic groups that are associated to the task force, collaborate to build the solutions together. “Our task force approach has proven to create the right environment to make continuous progress on different complex bioinformatics challenges,” states Rob Hooft, leader of the BioAssist engineering team.

Progress and problems encountered in all task forces are discussed by the project leaders during weekly engineering team meetings so that the task forces can also learn from each other’s experience. Next to their project leader role, the members of the engineering team also work on special software projects together, developing academic results into tools that are more suitable for use by others or for use in commercial applications. Rob Hooft explains: “This way of working with an engineering team may be a model for DT-I-DISC too.” Having professional software engineers as project leaders for task forces encourages increased reliability of programs and together with the collaborative development it also leads to better maintainability of the code. “In task forces and the engineering team we take academic code one step further,” Rob Hooft concludes. “And new task forces are welcome. We often find surprising overlap between seemingly distant efforts; joining forces can only improve these benefits further.”

Open source and open access have become widely accepted, but even open tools allow business opportunities. Software engineers belonging to the BioAssist engineering team next to their project leader role, the members of the engineering team also work on special software projects together, developing academic results into tools that are more suitable for use by others or for use in commercial applications. Rob Hooft explains: “This way of working with an engineering team may be a model for DT-I-DISC too.” Having professional software engineers as project leaders for task forces encourages increased reliability of programs and together with the collaborative development it also leads to better maintainability of the code. “In task forces and the engineering team we take academic code one step further,” Rob Hooft concludes. “And new task forces are welcome. We often find surprising overlap between seemingly distant efforts; joining forces can only improve these benefits further.”

“We tackle bioinformatics problems on a level that surpasses individual groups, but that are becoming relevant for the overall research community.”

“We take academic prototypes one step further along in their development and make them available to a larger user group.”

“What we do is turning a new method into a sustainable and user-friendly tool, without interfering with the functionality.”

“Open source and open access have become widely accepted, but even open tools allow business opportunities.”

“Making other people’s data work”
Infrastructure & Engineering

Facts & Faces

Bioinformatics Research Support
The Bioinformatics Research Support group (BRS) offers direct help to end-users (life scientists) addressing practical problems which can be solved using custom-made bioinformatics solutions.

WikiPathways
Pathways for the People
WikiPathways, co-developed by Maastricht University, comprises an open, collaborative platform dedicated to the curation of biological pathways that allows for participation by the community. WikiPathways presents a new model for pathway databases that enhances and complements ongoing efforts, such as KEGG, Reactome and Pathway Commons.

BioAssist programmers meeting
The NBIC BioAssist programme calls all of the scientific programmers together once a month for a meeting aimed to encourage collaboration and communication. The meetings consist of lectures, workshops and discussion.

PDB REDO
The CMBI in Nijmegen developed re-refinement procedures to assess and improve the quality of the experimentally dissolved protein structures in the Protein Data Bank, PDB. The updated and optimized protein structures are available through the PDB_REDO databank.

molgenis
molgenis is an open source framework developed in Groningen to handle the enormous floods of post-genomic data. This information management system enables to generate a complete database system with associated web site which allows to add data and query it.

HPC Cloud
HPC Cloud Computing is part of the infrastructure at SURFsara bringing fast compute clusters within the reach of scientists. Within ‘the HPC Cloud’ they can use a computer environment that is virtually identical to the environment that they have developed for their own internal use – but one which is many times faster.
International

Bioinformatics is not confined to national boundaries. Joining forces with international bioinformatics centres has been a key objective within NBIC’s strategy. Typically the development of open source and open access platform technology, for example, needs an international approach. All involved parties are struggling to find new ways to maintain and develop their business angle in this new field. That is why the international partners frequently organize workshops and jointly discuss, for instance, business models focused on data sharing.

On the next pages four prominent bioinformatics experts from abroad speak about the Dutch bioinformatics community, each focusing on a specific topic. Niklas Blomberg from Sweden (AstraZeneca and ELIXIR Founding Director) elucidates the role of DISC as the Dutch ‘node’ in ELIXIR. Tommi Nyrönen from Finland (CSC) talks about the NBIC training and education programme, which has led to NBIC as founding partner of the international network GOBLET. Ron Appel from Switzerland (SIB) discusses the importance of linking bioinformaticians across the country as has been realized in the Netherlands, and Ewan Birney from England (EBI) recommends the Dutch way of doing sciences: ‘everything is organized and done in consortia which provides some critical mass’.

Outreach

Learning bioinformatics with the greatest of ease. Young pupils are potentially tomorrow’s scientists. Therefore NBIC brings bioinformatics to the classroom and public events.
Today, it has become completely common for life scientists to integrate bioinformatics and bioinformaticians in their research. More and more though, bioinformatics is needed beyond research. There is no doubt that in the coming years, clinical and translational bioinformatics will become a key part of our health system. As a result, a well-coordinated bioinformatics infrastructure will be more important than ever before.”

“In the Netherlands, NBIC has succeeded in linking bioinformaticians across the country and in building a sustainable bioinformatics infrastructure, an achievement matched only by very few countries. Due to its success in building a well-coordinated bioinformatics infrastructure, an achievement matched only by very few countries, NBIC has become a key part of our health system. As a result, a well-coordinated bioinformatics infrastructure will be more important than ever before.”

“The future of life sciences research depends on bioinformatics”

“International networks provide access to versatile bioinformatics”

“The real bottleneck is skilled people”

“The Netherlands will make a significant contribution to ELIXIR”

“During the preparative stages of the European ELIXIR data infrastructure, I have had a lot of contact with the expert training staff at NBIC and colleagues from other centres, outside Europe. We learned a lot from these interactions and one of the problems that clearly stands out is the very small number of topical bioinformatics experts who can also deliver good training.”

“To be successful, trainers specialize in a particular area of bioinformatics. International exchange and networks provide access to the limited number of versatile experts that can be asked for locally organized training events. Another important aspect of international collaboration concerns the exchange of e-learning and training materials.”

“Recently, the GOBLET network started and I think this holds great potential since the founding team are all excellent and experienced trainers affiliated to recognized organizations. Through GOBLET, we can set up a coordinated approach that will generate greater value from bioinformatics training than when we would all try to do it on our own.”

“From a historical perspective, biology is a natural, quantitative science. But right now, bioinformatics is becoming the bottleneck of biology, not only because it has become essential to almost any biological experiment, but also because the costs of sequencing are falling at an incredible pace. Although there are technical challenges to be solved, the real bottleneck in bioinformatics is skilled people who can engage with the biology and have quantitative skills.”

“There is still this idea in biology that you don’t need mathematics. Making up for this lack is almost impossible and we should make sure that every biology student has a firm knowledge of mathematics. Dealing with this as a community, as you are doing in the Netherlands, is very productive. Everything is organized and done in consortia which provides critical mass. This is very important in setting up good bioinformatics training programmes in biology, for truly integrating computational biology in biology. We need that more than anything else. Computer science and statistics are natural partners of biology.”

“Biology is entering the Big Data-era: modern technologies such as genomic sequencing and text analytics are reshaping and rescaling scientific data analysis. This creates multiple challenges for scientists: relevant reference data need to be identified and diverse types of data need to be integrated, analyzed and visualized in the context of newly generated findings.”

“The diversity and volumes of data require a solid understanding of the methods used and the origin of the data – provenance is key. The pan-European research infrastructure for life sciences data ELIXIR will drive data integration at high level. Through ELIXIR, researchers will find it easier to cross-reference data and exploit innovative lines of research.”

“With NBIC and DISC, the Netherlands has built a well-organized and influential bioinformatics community, which is scientifically recognized on the European and global level. The Netherlands will make a significant contribution to ELIXIR by sharing its experience and expertise in areas such as training, professional software engineering, data standards and interoperability.”
GOBLET
The Global Organisation for Bioinformatics Learning, Education and Training (GOBLET) coordinates world-wide bioinformatics training activities. The people sitting on the staircase are the representatives of over 20 international organizations at the kick-off meeting hosted by NBIC in Amsterdam (2012).

Wooden shoe
Typical Dutch ‘design’ to attract the attention from international conference participants to the Netherlands bioinformatics community.

Galaxy Community Conference
In 2011 NBIC hosted the international community conference of Galaxy. Galaxy has been used as the main integration platform in the NBIC BioAssist program to leverage the bioinformatics strength of various member groups.

ELIXIR workshop
The purpose of ELIXIR is to construct and operate a sustainable infrastructure for biological information in Europe to support life sciences research. In March 2013 NBIC hosted a workshop for representatives of the ELIXIR nodes in Noordwijk aan Zee.

Bioinformatics Benelux Conference
NBIC co-organized the 2012-edition of the Benelux Bioinformatics Conference (BBC) together with CMI in Nijmegen. Isabel Duarte, researcher of CMI, took photos and tweeted them to share the conference experiences with interested researchers who were not able to participate.

Education
NBIC’s BioWise offers a comprehensive PhD School program of advanced courses on a variety of topics and technologies along three tracks: technology, application and life sciences. The courses are accessible to PhD students and researchers worldwide. To broaden the international scope, courses have been set up with sister institutions e.g. the Swiss Institute of Bioinformatics. In addition to training students and researchers, teach-the-teacher training is part of the BioWise portfolio.
Modern research in life sciences is characterized by the increasing volume and complexity of the data involved. Bioinformatics tools and approaches are crucial for processing and interpreting these complex datasets and for generating meaningful biological knowledge. Bioinformatics basically yields acceleration of R&D, with innovative software being just part of its product. During the almost ten years that NBIC has been around, much effort has been dedicated to positioning bioinformatics as a key area within the life sciences. Any area with a life sciences component should be able to tap the bioinformatics resources present in the international field and in NBIC.

**Nutrition**

Nutritional science is extremely complicated because the effects of diet on health are very subtle and involve multiple (molecular) processes in our physiology: a systems-level approach is essential.

- John van Duynhoven (Unilever) emphasizes the need for a coherent, innovative and accessible bioinformatics infrastructure to integrate all different metabolic elements in human physiology (p28).

**Agro**

Whereas breeders were provided with useful but anonymous molecular markers in the past, the combination of genetic mapping, genome sequencing and bioinformatics now speeds up the process to the unravelling of genes and genetic networks that underlie important agronomical traits in crops and livestock.

- Gabino Sanchez Perez and Martien Groenen (Wageningen University and Research Centre) explain how bioinformatics provides an invaluable basis for their biological research and breeding applications (p28).

**Health**

Next generation sequencing and ‘omics’ technologies have turned ‘health’ into one of the fastest growing areas in the life sciences. Bioinformatics to store, decipher and functionally elucidate the tremendous data flow in clinical research has moved to centre stage.

- Gerrit Meijer (VUmc) states that current translational health research urgently needs the translation of new research findings into concrete applications that benefit patients (p29).

**Biotech**

Bioinformatics has become an essential discipline also for the development of the next generation of microbial production chains. It brings a completely new perspective to the design and generation of improved bioproducts with new functionalities.

- Hans Roubos (DSM) illustrates how bioinformatics has become a key enabler for innovation in industrial biotechnology (p29).
“Towards a coherent infrastructure”

For the food industry, the focus is shifting towards products that contribute to health maintenance or even better: health optimization. To understand how our diet and changes therein affect our health status, we need to measure the body’s response not only on different levels – genes, proteins, metabolites – but also in different time frames. Without access to bioinformatics expertise and a top-level infrastructure, there is no way we can effectively handle this data deluge. Thanks to substantial investments during the past years, tools and methods have been developed and through NBIC and its collaboration with the Netherlands Metabolomics Centre (NMiC), a bioinformatics infrastructure has been built. What we need to do now is to integrate these different elements into a coherent, innovative and accessible infrastructure. This is exactly what the Dutch Techcentre for the Life Sciences, DTL, envisions and that is why we strongly support this initiative.”

“Maintaining close relationships”

Within Life Sciences & Health the core objective is to translate new research findings into concrete applications that benefit patients. This requires large-scale and complex measurements of different types of patient samples, which obviously generates massive read-outs and thus large volumes of data. The main challenge is to turn all this data into information that helps to improve diagnosis and/or treatment. Clearly, bioinformatics has a key role to play here and increasingly, the bioinformatician is becoming a central player in the medical field. The interaction between physicians, molecular biologists and bioinformaticians will get stronger, but it is very important that bioinformaticians also maintain close relationships with each other. Like in, for example, the Translational Research IT (TraIT) project of the Centre for Translational Molecular Medicine. For the future, we will still need a structure or environment where bioinformaticians can interact and exchange ideas.”

“We can now employ a rational approach towards metabolic and protein engineering. From wet lab modifications and analysis, the focus has shifted to in silico exploration and prediction, followed by computer-aided design and DNA synthesis. Biology, informatics and the various omics-platforms get more and more integrated. That requires a coordinated, multidisciplinary effort that focuses on training, standardization and making the various levels of knowledge easily accessible.”

“In both plant and animal research, the advances in genomics and especially now the emergence of Next Generation Sequencing have changed these fields completely. The data volumes we are dealing with have grown so immensely that without bioinformatics, molecular biology has simply become impossible. We are now able to look at complete genomes and their dynamics. More and more, we are gaining access to the systems level. There is an intense democratization process ongoing now that everybody can potentially tap into this wealth of biological information. However, what we desperately need is integration of all this different -omics data. The Dutch Techcentre for the Life Sciences, DTL, has a huge role to play in this respect. DTL is all about integration and provides the perfect entity where developers and users can interact and where training and support can be organized and provided to the community.”

“Enabling a rational approach”

“During the past ten years, the importance of bioinformatics in industrial biotechnology R&D has grown tremendously. As the application areas of industrial biotechnology include large sectors such as food, pharmaceuticals and biobased chemicals and fuels, bioinformatics has become a key enabler for innovation in these areas as well. It has brought about a completely new perspective on the design and generation of improved strains or enzymes with new functionalities.”

“It is all about integration”

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The NBIC team: the driving force behind the Dutch bioinformatics community. They staff the daily office and provide support to the many NBIC activities and NBIC programmes.