Past Five

*Born from collaboration, BICB marks its fifth year with growth*

As a member of the Rochester Higher Education Development Committee (RHEDC), Drew Flada remembers the conversations that gave birth to the Biomedical Informatics and Computational Biology (BICB) Program.

Formed by Governor Tim Pawlenty in 2005, the RHEDC tackled the challenge of developing a plan to advance higher education in the region in a way that also leveraged and bolstered the region’s resources. Flada and other business and education leaders began their work, which led to a recommendation for an institution of higher education with education, research, and outreach initiatives that support the region’s economic health. The committee also considered educational programs with the greatest potential for impact.

“Rochester always has been in a unique confluence of health care and information technology,” says Flada, director of cloud computing and emerging technologies at IBM. Health care, technology, bioscience, engineering, and entrepreneurship all ranked as vital to the economy.

Committee members identified bioinformatics and computational biology as emerging areas with great potential to advance health care, technology, and entrepreneurship. “When we looked at what we needed going forward, those were skills and capabilities that we didn’t really have but were important to the future,” says Flada.

“We had focused on developing the graduate degrees first,” says Flada. “BICB really was the starting point for further development of the UMR campus.”

**Lasting Partnerships**

From the very beginning, an impressive group of partners agreed to lend their support in shaping and supporting the program.

In 2007, James Maher, Ph.D., was serving as associate dean for academic affairs at Mayo Graduate School when he learned about the BICB concept. Then Diane Jelinek, Ph.D., Mayo Graduate School dean, joined the task force to develop the program.

“Mayo Graduate School has been an active and enthusiastic partner, eagerly interested in the success of the program,” says Maher, currently Mayo Graduate School dean, and professor and vice chair of the Department of Biochemistry and Molecular Biology in the College of Medicine, Mayo Clinic. Five partners – University of Minnesota Rochester, Mayo Clinic, IBM, The Hormel Institute, and the University of Minnesota Twin Cities – joined forces to launch new education and research initiatives.

In collaboration with those partners, academic leaders, Claudia Neuhauser, vice chancellor for academic affairs at UMR and director of graduate studies for the BICB Program, Vipin Kumar, head of the computer science and engineering department and William Norris Professor, Dick Westerlund, then interim vice chancellor for academic affairs, and Jim Clausen, project...
management consultant, moved forward with planning for BICB degree and research programs.

“It was exciting and energizing to develop this new initiative,” says Neuhauser. “Faculty members from different disciplines, too, were excited by the possibilities of integrating their expertise to advance research and education at the intersection of quantitative sciences, biology, and medicine in new and powerful ways.”

In 2007, with degree programs in development, BICB launched three early initiatives: seed grants to support interdisciplinary research among partners; traineeships where industry participants pursued research in collaboration with BICB partners; and symposiums where academic and industry researchers shared ideas and approaches.

“BICB has pioneered a model of collaboration that truly benefits the community in Rochester and beyond,” says Stephen Lehmkuhle, who became UMR’s first chancellor in 2007. “These collaborations serve as a powerful foundation for UMR and help UMR contribute to the region’s economic health.”

Flaada agrees: “BICB helped differentiate the campus, and it’s really unique in starting with collaboration as its base.”

**Impacts**

By July 2008, the University of Minnesota Board of Regents approved the new M.S. and Ph.D. programs in biomedical informatics and computational biology, and the BICB graduate program welcomed its first students in fall 2008.

The program helps meet the needs of industry and the growing demand for scientists with such interdisciplinary training.

“Although Mayo Graduate School provides many diverse educational development and degree opportunities for staff, BICB’s graduate degree programs help with math-based biology,” says Maher.

“A number of Mayo Clinic employees are engaging in career development through BICB courses. Several Ph.D. and M.D. students have been involved and others are actively pursuing opportunities because they want to take advantage of BICB quantitative insights and perspectives.”

BICB offers flexible tools, from online courses to research partnerships to projects that end with an M.S. degree. “This flexibility is unusual,” Maher says. “This means that students can be served at various levels, from consultation to adding an M.S. degree to their Ph.D. or M.D./Ph.D. plans.”

In 2010, the BICB Program graduated its first master’s student, and in 2012, it granted its first Ph.D. degree (see story on page 5). The program currently has 56 faculty members with 45 graduate students in fall 2011.

“Cray brings life sciences industry expertise in the HPC arena to the partnership,” says Carlos Sosa, applications engineer at Cray and BICB adjunct faculty member. “With their highly scalable and affordable networks combined with unmatched compute density, cutting-edge research. Each year, we enroll more students.”

**Continued Growth**

Most recently, in 2012, the BICB Program welcomed a new partner: Cray.

2005: Rochester Higher Education Development Committee (RHEDC) meets

2006: University of Minnesota Rochester (UMR) receives designation as official University of Minnesota coordinate campus

2007: BICB offers seed grants and traineeships; BICB hosts its first symposium; UMR moves into University Square in downtown Rochester; Stephen Lehmkuhle becomes UMR’s first chancellor

2008: BICB receives approval from University to offer M.S. and Ph.D. degree programs; first students enter in fall; BICB receives high-performance computing equipment grant from IBM

2009: BICB symposium grows to attract more than 140 participants

2010: BICB graduates its first master’s student

2011: BICB adds entrepreneurship and leadership seminar to the curriculum

2012: BICB graduates its first Ph.D. student; BICB welcomes new director of business development

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Interdisciplinary Success

NSF recognizes Rui Kuang with CAREER Award

Rui Kuang applies his expertise in machine learning techniques to some of the most complex and important biological issues, and in recognition of his contributions, the National Science Foundation (NSF) awarded him a 2012 Faculty Early Career Development (CAREER) Award.

One of the NSF’s most prestigious honors, the CAREER Award supports promising faculty members at the early stages of their career. For Kuang, assistant professor of computer science and adjunct professor of biomedical informatics and computational biology, that career involves conducting research at the intersection of medicine, biology, and computer science.

“My research is in the biomedical informatics and computational biology area,” says Kuang, who was eager to join the BICB Program. “It brings together faculty members from throughout the University with this interest, and we also are able to connect with others in industry.”

In his lab, Kuang focuses on the development of machine-learning algorithms to extract and integrate subtle and elusive information that is available, but often hidden, in genome-wide large-scale biological data with the goal of understanding the association between genomic characteristics and phenotypes. In particular, Kuang is interested in designing novel kernel methods and graph-based learning algorithms for a unified analysis of high-throughput data in a data-driven perspective.

As part of the NSF award grant, Predicting and Mining Phenome-Genome Association across Species, Kuang and his lab will continue investigating new computational methods for predicting and understanding the relationship between a whole collection of phenotypes and the complete genome across multiple species. The work helps researchers make new links and inferences about diseases, says Kuang.

“We are looking at the same phenotypes of gene associations and at the relationships between a group of diseases and a group of genes,” says Kuang. “We also are looking at other species and conducting a cross species analysis.”

Kuang also conducts research in the area of cancer genomics, and worked with colleagues on a project to develop new methods for analyzing genetic data from breast cancer survivors. The BICB Program has helped him advance work in this area.

At a BICB Program symposium, for example, Kuang met Jeremy Chien, Ph.D., from Mayo Clinic, and the two began collaborating on work to better understand the factors that are related to recurrences of ovarian cancer. The effort involves applying computational techniques to large genome datasets, as well as development of different types of algorithms for building predictive models and mining biomarkers of cancer phenotypes from microarray gene expressions.

The researchers are looking for patterns and ways to use genes as a biomarker to predict a recurrence of ovarian cancer.

Kuang has a long-standing interest in applying computational techniques to biology. “I always wondered how computation could be used for genome analysis,” says Kuang, who received his master’s degree in computer science from Temple University and his Ph.D. in computer science from Columbia University.

He received a seed grant from the BICB Program, and those results helped him land additional funding. He also has advised several BICB Ph.D. students.

“As faculty members, it is very important to have this opportunity to talk to researchers in other departments at the University,” says Kuang. “It supports interdisciplinary research. It is also a bridge to researchers at Mayo Clinic and IBM.”

In the future, there will be only more opportunity in biomedical informatics and computational biology, he says.

“All of this will grow, driven by needs and driven by technology. We have all this data that can be used for application. Bioinformatics is the vehicle to apply the data. I am excited by it, because I think in the next 10 years, our lives will be changed by the data.”
National Recognition

BICB student receives NSF fellowship honor

Margaret Mahan, BICB Ph.D. student and recipient of a NSF Graduate Research Fellowship, with her primary research advisor Apostolos Georgopoulos (on right), M.D., Ph.D., Regents Professor of Neuroscience, and co-adviser, John Carlis (on left), Ph.D., computer science and engineering professor and BICB associate director of graduate studies.

Margaret Mahan’s involvement in a novel research project to identify the qualities of a healthy brain led to a coveted award from the National Science Foundation (NSF).

In March, Mahan, BICB Ph.D. student, received a NSF Graduate Research Fellowship, which will support her research for three years. The highly competitive NSF fellowship program recognizes outstanding graduate students who are pursuing research-based graduate degrees and demonstrate their potential for achievement in science and engineering.

Last summer, Mahan began a rotation at the Brain Sciences Center of the University of Minnesota and the Minneapolis Veterans Affairs Medical Center. There she became involved with the Women Healthy Brain Aging Project, a long-term research initiative of the center that seeks to understand brain aging and resiliency.

“The rotation was a learning experience, and I was able to see what it would be like to do this,” she says. “Working on this study has been a great experience.”

The center is amassing a huge database for this first-ever healthy brain study, and with skills in biomedical informatics and computational biology, Mahan is refining and applying analysis methods to help unlock the secrets of the data.

The project aims to derive a comprehensive, multimodal, integrative assessment of brain status and relate it to cognition, language, and genomics across the lifespan. The “proposed project also has potential to be of immense value broadly to the society,” according to one NSF reviewer.

Primary research adviser, Apostolos Georgopoulos, M.D., Ph.D., Regents Professor of Neuroscience, director of the Brain Sciences Center, and primary investigator for the Women Healthy Brain Aging Project, and co-adviser, John Carlis, Ph.D., computer science and engineering professor, BICB faculty member, and BICB associate director of graduate studies, help guide her research efforts.

Her work on the project and in the BICB Program helped cement her desire to conduct research for the rest of her life. “The fellowship will allow me to focus on scientific discovery,” she says. The fellowship offers her additional resources as she continues her studies. “It’s nice to know that for the next three years, I can focus solely on my research.”

Mahan entered the BICB Program in 2010 as a master’s student. With an undergraduate focus on both biology and psychology, she was looking for a graduate program that combined her skills in math with her love of neuroscience. “This was the only program where I could blend and apply those two,” she says. “I am able to mold what I need for my program.”

Dissertation Support

Sue Van Riper, BICB Ph.D. student, received a Doctoral Dissertation Fellowship from the University’s Graduate School in May.

The school awarded only 137 fellowships to outstanding final-year Ph.D. candidates. Van Riper’s research focuses on computational proteomics for protein and peptide biomarker discovery. As part of a collaborative effort with the Dental School, Medical School, computer science, and biostatistics, she takes an interdisciplinary approach to study oral cancer progression.

The award will help Van Riper with her dissertation, which explores novel algorithms, tools, and workflows that characterize peptidomes. She received her bachelor’s degree in computer information systems from Winona State University and her master’s degree in software engineering from the University. She is also completing a master’s degree in computer science. She plans to finish her dissertation by May 2013.

“The BICB Program is ideal for me because my research is at the interface of computer and life sciences,” says Van Riper. “The BICB Program is flexible, allowing me to tailor my Ph.D. program to fit my needs. In addition to the fundamental knowledge I gained from the course work, I continue to enhance my skill set in preparation for becoming an independent researcher.”
Important First
Joshua Baller becomes BICB’s first Ph.D. graduate

In March, Joshua Baller marked an important personal milestone, also helping the BICB Program mark an important milestone.

Baller is the first Ph.D. student to graduate from the BICB Program. He began his Ph.D. work in 2008, just as the BICB Program began offering its graduate degree programs.

Even as an undergraduate student, Baller had a deep interest in education, and that interest led him to consider graduate school options.

“I enjoy learning and the natural extension of learning is to conduct research that adds to the body of knowledge,” says Baller, who received his bachelor's degrees mathematics and biology from the University of Minnesota. “Pursuing a Ph.D. seemed like the most obvious way to take that next step.”

The summer before he finished his undergraduate work, Baller heard about the BICB Program, and was immediately intrigued. Other programs that he considered required more of a focus in one area or the other. “Based on my undergraduate work, I had an interest in combining biology and computation,” he says. “The BICB Program drew me to it.”

The program offered Baller the opportunity to explore diverse territory. Dan Voytas, professor of genetics and cell biology and development and director of the Center for Genome Engineering, and Chad Myers, assistant professor of computer science and engineering and BICB faculty member, served as his advisers.

“The BICB Program is very flexible,” he says. “There is a set of core requirements you need to complete, but you get to decide what other classes will work best for your interests.”

Baller spent his first year in the program in part enhancing his biology background through graduate-level work. He also completed rotations in three different biology labs, choosing those labs based on his interests and the complexity of the problems under investigation.

Those experiences led Baller to focus his thesis research on understanding how chromatin affects the targeting of site-specific changes to the chromosomes. In his thesis, he identified factors that drive targeting of chromosome modifying elements, which make alterations to chromatin or sequence. He applied high-throughput sequencing to map sites of modification genome-wide. The data, in conjunction with machine learning techniques, identified chromatin features associated with the targeted integration of the Ty1 and Ty5 retrotransposons as well as the firing of origins of replication.

An understanding of targeting determinants helps researchers more accurately predict the events that happen on the chromosome and potentially direct them. Such knowledge has direct applications to genomics and gene therapy.

Increasingly, Baller sees a need for such interdisciplinary work. “BICB helps develop researchers who are conversant in both biology and computer science,” says Baller. “BICB is able to train researchers with this expertise.”

The future only will bring increasing amounts of data, says Baller, and interdisciplinary approaches, such as those promoted by the BICB Program, are key to making the most of the data. “There are plenty of new discoveries that are going to come out of the intersection of these fields.”
The Big Picture

New BICB course offers students perspectives on the management of technology

When Ph.D. student Seung Ho Shin registered for the Introduction to Technological Leadership and Management course, he wasn’t exactly sure what to expect, but by the end of the course, he was very clear about its value.

“The class turned out to be one of the best courses I’ve attended,” says Shin, who just finished his first year in the BICB Ph.D. Program. “I realized that scientists can have huge impacts on the world – more than we expect.”

His response is exactly the kind that course organizers wanted. Massoud Amin, director of the Technological Leadership Institute (TLI) at the University of Minnesota, Honeywell/H.W. Sweatt Chair in Technological Leadership, and electrical and computer engineering professor, and his team from TLI developed this course for especially for the BICB Program.

Amin joined the BICB faculty when the program was being planned and has been a founding graduate faculty member, with the aim of offering BICB students a vital perspective that many science and engineering students never experience as part of their studies – the intersection of management and technology. As the first public university to offer a master of science degree in the management of technology (MOT), the University has a worldwide reputation for its focus on technological leadership, with more than 1,100 alumni of TLI’s graduate degrees, who hold executive and leadership roles in more than 400 enterprises.

“We looked at our curriculum and did a careful assessment to bring the most pertinent best of MOT to the BICB classroom,” says Amin. The course hits the high points of technological leadership and management, and trains students with the assessment tools for pivotal and emerging technologies; technology foresight and forecasting; science and technology policy; the strategic management of technology; and with the development of risk-managed options to move ideas from laboratory to the marketplace.

The best of the MOT DNA also includes several other important features, says Amin, “We judiciously selected and synthesized the most pertinent parts from five MOT courses and developed new material for the BICB students combined with effective teaming.” Since its start in 1990, the MOT program has emphasized working in teams and completing a final applied project that helps students put what they learned into practice. Amin incorporated those elements into the BICB course.

As part of the course, students completed a final project by working in teams. They considered key pivotal technologies, identified emerging market needs and technology development opportunities, and mapped the Technology Power Zone™ to help assess the influence of and potential of emerging technologies. They also analyzed the potential business impact and policy issues. In the end, they completed a paper and final presentation on their findings.

Shin worked with two fellow Ph.D. students on a project that assessed the potential of saline agriculture as an approach to deal with water shortages and to develop salt-resistant crops. “I totally enjoyed learning from the other two members of my team,” he says.

The hybrid course involved a combination of live and online sessions. Other key MOT faculty members – Lockwood Carlson, James Renier Chair in Technological Leadership, Dennis Polla, Honeywell/William R. Sweatt Chair in Management of Technology, and Tess Surprenant, the then-Gemini Chair in Technology Management – also recorded one-hour video lectures on their area of expertise for the students. These included nanotechnology, medical devices, strategic technology assessment, effective teaming, and leadership.

The first offering of the class took place in fall 2011. “We had terrific and highly engaged students in the inaugural class,” says Amin.

A student team worked on a project to assess the potential of saline agriculture as an approach to deal with water shortages and to develop salt-resistant crops.
Driving Innovation Through Teamwork and Partnerships

New BICB director of business development looks to increase the impact of BICB partnerships

As a former manager with responsibility for the development of technology products, Steve Smith understands firsthand the value of innovation. He also knows the importance of research and the power of teamwork in moving innovations forward.

In his new position, as director of business development for the Biomedical Informatics and Computational Biology (BICB) Program at the University of Minnesota Rochester (UMR), Smith continues his work to advance bioscience and technology in the region by moving the model of traditional collaboration among industry and the University to one that includes and emphasizes integrated teamwork and shared responsibilities.

Smith began his career at IBM – Rochester, and served in a variety of management positions, including director of the Hard Disk Drive Development Laboratory. He later became senior director and site general manager for the Rochester Hard Disk Drive Development Laboratory at Hitachi Global Storage Technologies.

“In my past roles at IBM and Hitachi, we benefited from relationships with a number of University faculty,” says Smith, who began his new role at BICB in March.

“Our work also relied on expertise from many different disciplines to solve problems. The BICB Program is built on a foundation of interdisciplinary education, research and teamwork that involve industry and the community. We are looking to address these exciting interdisciplinary challenges in bioinformatics and health care that include a unified and integrated approach with our students, faculty, and industry partners. I’m looking forward to expanding on that concept.”

As director of business development, Smith leads the BICB Program’s efforts to further grow its outreach to industry and the community with the aim of facilitating the innovations that support both new breakthroughs and economic growth for the area and the state. Smith already has begun discussions with business and community leaders about the benefits of BICB partnership.

“With its interdisciplinary approach, the BICB Program supports research and graduate education in diverse areas of application,” says Stephen Lehmkuhle, UMR chancellor. “The addition of Steve to the BICB Program will allow us to expand on our already strong existing partnerships with IBM, Mayo Clinic, The Hormel Institute, the University of Minnesota Twin Cities, and most recently Cray, and increase the impact of our leading-edge work.”

Smith currently supports two community initiatives. He chairs the Southeast Minnesota BioBusiness Development Champions Group, an advisory committee for the formation and growth of biobusiness in the southeast region of Minnesota. He also is a former board member and board chair for the Southern Minnesota Initiative Foundation (SMIF) and serves on the SMIF’s Intake Review Board for the Minnesota Angel Network.

“Steve is well-regarded for his work at IBM and Hitachi and has a keen understanding of the technology development process and the role that research plays in facilitating new innovations,” says Claudia Neuhauser, vice chancellor for academic affairs at UMR and director of graduate studies for the BICB Program. “His work will only help us maximize the contributions that we can make.”

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The Big Picture continued from page 6

Amin. “When they gave their final presentations, they were positive and energetic and did a high level of work.”

Students also responded in kind, giving the class extremely high ratings. Amin looks forward to the next class, which is scheduled for fall. For students, the class provides a perspective that isn’t often available, and takes at least five years to gain in the work place.

“The course provides a 360-degree, high-level systems view of science and technology enterprises,” says Amin. “It helps students understand what needs to be done to move an idea forward in their organization.”

Shin agrees about the value of better understanding technological leadership. “We have to see the big picture before starting research to ensure that our work can contribute to removing major hurdles in solving problems in human health, energy, and other areas,” says Shin.
Milestones

- **Cray** recently announced a partnership with the BICB Program (see story on page 2). Cray brings life sciences and industry expertise in the HPC arena to the partnership.

- **Dimitrije Jevremovic**, former BICB trainee and Ph.D. candidate in computer science with a BICB minor, recently received the prestigious IBM Ph.D. Fellowship for a third year. The fellowship supports his research on the analysis of metabolic pathways in biochemical reaction networks, which is an outgrowth of the work that he began as part of a BICB traineeship in 2007.

- **Chad Myers**, assistant professor of computer science and engineering and McKnight Land-Grant Professor, received a National Science Foundation grant. Ivan Baxter from Danforth Center in St. Louis, Missouri, serves as co-principal investigator. The award is supporting the development and application of computational tools for using co-expression networks to aid in identifying candidate genes from genome-wide association studies in maize. Rob Schaefer, BICB Ph.D. student, was instrumental in conducting preliminary analysis and building prototype software that supported the grant award.

- **Carlos P. Sosa**, affiliated BICB faculty member, has accepted a new position as an applications engineer at Cray, Inc., working with chemistry and life sciences applications. He also will be responsible for market development and partnership programs aimed at the life sciences segment.

- **Austin Shin**, second-year BICB Ph.D. student, received a full travel fellowship to attend the ESPCA CBADD Conference in Sao Paulo, Brazil, which was held April 1-6. Only five graduate students were selected from the U.S.

- Two articles by **Wei-Qi Wei**, M.D., Ph.D., based on work that was completed as part of BICB, were accepted for publishing in two top medical informatics journals, the *Journal of the American Medical Informatics Association* and the *International Journal of Medical Informatics*.

For information about BICB Programs, visit [www.r.umn.edu/research/bicb/index.htm](http://www.r.umn.edu/research/bicb/index.htm) or contact:

**Michael Olesen**  
Director of IT, Bioscience, and Research  
University of Minnesota Rochester  
111 South Broadway • Rochester, MN 55904  
Office: 507-258-8018 • E-mail: olesen001@umn.edu  
Fax: 507-280-2820

*This bulletin is available in alternative forms upon request by individuals with disabilities. Please send email to olesen001@umn.edu or call 507-258-8018*

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