b-it

Bonn-Aachen International Center for Information Technology

Annual Report
2017

Foreword by the Chair
of the b-it Foundation

Annette Storsberg

The recently elected new North Rhine-Westfalian state government under Prime Minister Laschet has decided to re-organize its cabinet by strengthening the links among culture and science in a newly formed Ministry.

The Bonn-Aachen International Center for Information Technology (b-it) has lived this linkage since its foundation in 2003 in several dimensions:

- As a pioneering worldwide cultural meeting point for high-quality students from over 40 countries who have formed a peaceful and innovative network community across widely different cultural backgrounds that extends well over their two years of study, as readers can see again from student stories in this report;

- By research and teaching support not only in the Media Informatics program where b-it has actively contributed to central cultural strategies such as the Route Charlemagne in Aachen and the Beethoven Fest in Bonn, but also through its international visibility in the hotly debated field of Autonomous Systems / Cognitive Robotics, and through advanced research and teaching in Life Science Informatics, e.g. concerning big data research in dementia and other diseases.

It will be quite interesting to further develop these relationships in the coming years, pursuing the ministry's strategy that aims to offer more freedom and autonomy to universities, and also promote further cooperative doctoral programs with universities of applied science such as Bonn-Rhein-Sieg.

The scientific quality and international visibility of the b-it team is exemplified by several important awards won in 2016-2017, including the first-ever American Chemical Society lifetime Award for Prof. Bajorath's research on Chemical Informatics, the selection of Prof. Borcher's Haptic Vest for visually impaired people as one of four lead exhibits at the 2017 BMBF Open Day, and once again several RoboCup World Championship titles in all three participating universities.

Finally, I would like to thank my predecessor Dr. Thomas Grünewald for his inspired leadership of the b-it Foundation Council, and the b-it scientific directors and their teams, especially Professor Kurt-Ullrich Witt who co-founded b-it in 2003 and retired end of 2016 after almost fourteen years of service as Scientific Co-Director.

Annette Storsberg
State Secretary, Ministry of Culture and Science NRW
Chair of the b-it Foundation Council

b-it Mission Statement

b-it is an international center for information technology. It is jointly carried by the leading universities and research institutes of the information technology region Bonn-Aachen. At b-it, a team of excellent scientific leaders attracts the best students from all over the world. At the same time, b-it is a strategic partner of the regional economy.

At b-it, research and teaching form an integrated unit at the highest level. International orientation and diversity are a particular asset and strength of our institution. In our teaching, we build on the complementary strength of our participating institutions.

Graduates of b-it are sought after as specialists and experts, regionally and internationally. They transport know-how and innovation into science and economy.

We are shaping the digital change in a dialog between economy and society. Our focus is Data Science in the application areas Media, Life Sciences and Autonomous Systems.

Report by the Scientific Directors

In the academic year 2016-2017, b-it further pursued the strategy defined in the 2016 evaluation and underlined by the very positive international ranking results for the computer science departments of the participating universities in Aachen and Bonn. Just one confirmation of the achieved standing is that no less than five excellence cluster proposals with (in part leading) participation by b-it directors and faculty have reached the final round of the 2018 German Excellence Competition, another the second prestigious research award for Prof. Bajorath by the ACS.

The increased data science focus mentioned in the b-it mission statement is reflected in our faculty development strategy. External co-funding has enabled the hiring of former Max Planck researcher Thomas Schultz as Associate Professor of Medical Image Analytics at the border of our study programs in Life Science Informatics and Media Informatics, and we are in the negotiation process for filling the Full Professorship for Data Science.

During the academic year, several changes in the leadership and study support of b-it occurred. We cordially welcome State Secretary Annette Storsberg as new Chairperson of the b-it Foundation Council and thank her predecessor, former Vice Minister Thomas Grünewald, for his continued support of b-it during his six-year tenure. We also express our sincere thanks to our recently retired colleague Kurt-Ulrich Witt for 13 years of inspired leadership as b-it Founding Director at Bonn-Rhein-Sieg University of Applied Sciences, and welcome Paul Plöger who was confirmed by the Foundation Council as his successor in late 2016. Last not least, cordial thanks go to Dr. Jürgen Rapp who moved from Aachen after over 12 years of enthusiastic service as study advisor Media Informatics; he is succeeded by Arnab Chakrabarti and René Röpke.

Matthias Jarke,
RWTH Aachen University and Fraunhofer FIT
Paul G. Plöger,
Bonn-Rhein-Sieg University of Applied Sciences
Stefan Wrobel,
University of Bonn and Fraunhofer IAIS

Prof. Dr. Matthias Jarke
RWTH Aachen University and Fraunhofer FIT

Prof. Paul G. Plöger
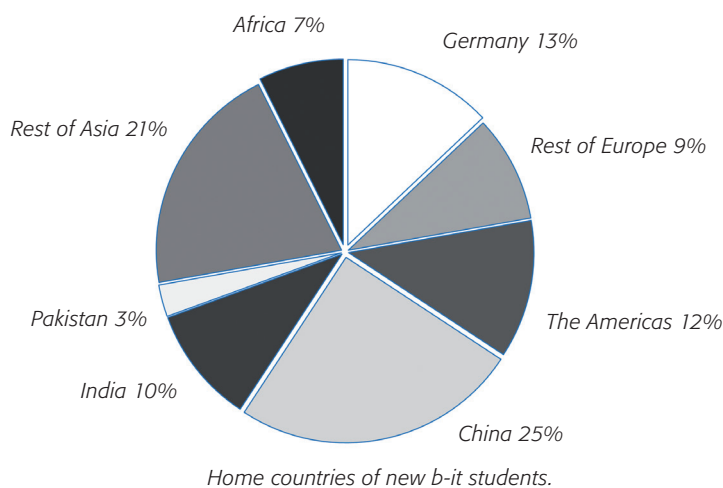*Bonn-Rhein-Sieg University of Applied Sciences*

Prof. Dr. Stefan Wrobel
University of Bonn and Fraunhofer IAIS

b-it in Profile

The southwest of North Rhine-Westphalia is one of the largest, most vibrant locations in the European media and telecom industry. It is also one of the most innovative and fast-growing biotech regions in Germany, and there is much interest in the emerging fields of mechatronics and robotics. To make it the optimal place to study for professional work in these fields, the Bonn-Aachen International Center for Information Technology (b-it) has been established as a joint venture of RWTH Aachen University, University of Bonn, Bonn-Rhine-Sieg University of Applied Science (BRSU) and the research institutes of the Fraunhofer Institute Center Birlinghoven Castle.

b-it offers highly selective International Master Programs in Applied IT, as well as summer / winter schools for qualified undergraduate computer science students. Most courses take place in the beautiful b-it building next to the former office of the German Chancellor on the banks of the River Rhine in Bonn. Admission to the b-it Master Programs is linked to, and conditional upon, placement in research lab courses at the participating Fraunhofer institutes. Students in good standing are offered financial support during these lab courses.

The b-it Universities Institute offers English language Master of Science (M.Sc.) programs in Media Informatics and Life Science Informatics, whereas the University of Applied Sciences offers a Master Program in Autonomous Systems. The Master Programs prepare students for successful international careers that require technical excellence and leadership, creativity and the ability to innovate. b-it master programs are distinguished by their international orientation (structured according to the European ECTS standard), their focus on IT competence, and the deep integration of teaching and research.

A second goal of b-it is the optimization and acceleration of existing undergraduate computer science curricula at Bonn University and RWTH Aachen University for selected top students. b-it's International Program of Excellence (IPEC) pursues this goal by compact course modules delivered in summer and winter schools during the semester breaks. The b-it Research School offers doctoral training.

For the participating universities, the b-it programs have also helped pave the way towards a smooth transition from the traditional German diploma system to the Bachelor-Master system following the Bologna accord; for example, the b-it master programs were the first to be accredited within the participating universities in 2004-2005, and re-accredited in 2010-2011. A comprehensive external evaluation in 2015 confirmed the very positive developments and stimulated a few new accents. The success of the b-it programs is also demonstrated by a very good placement record, both in science and industry.

b-it is financially supported by a 56 M € Foundation initiated through the Bonn-Berlin program of the German federal government, as well as by matching NRW state funds.

Home countries of new b-it students.

Africa 7%
Germany 13%
Rest of Asia 21%
Rest of Europe 9%
The Americas 12%
Pakistan 3%
India 10%
China 25%

Honors and Awards

New b-it Director

In November 2016, b-it Prof. Paul G. Plöger succeeded Founding Director Prof. Kurt-Ulrich Witt. Prof. Witt has been founding director of b-it for 14 years. b-it warmly thanks Prof. Witt for his tireless and very successful efforts as b-it director. b-it welcomes Prof. Paul G. Plöger as new b-it director for the University of Applied Sciences Bonn-Rhein-Sieg.

ACS Award for Computers in Chemical and Pharmaceutical Research for Prof. Jürgen Bajorath

Prof. Jürgen Bajorath is the recipient of the prestigious 2018 National Award of the American Chemical Society for Computers in Chemical and Pharmaceutical Research. This award is sponsored by the ACS Division of Computers in Chemistry. It was awarded for his "[...] development and application of chemoinformatics and computational chemistry solutions to research problems in medicinal chemistry, chemical biology, and the life sciences." b-it congratulates Prof. Bajorath on this outstanding achievement! This is the third award in a row Prof. Bajorath receives after having been selected for the 2015 Herman Skolnik Award and the Inaugural Fujita Award in 2016.

MAS student Padmaja Kulkarni wins the 2017 Silvia Coradeschi RoboCup Award

Padmaja Kulkarni was the winner of the 2017 Silvia Coradeschi Award at the RoboCup World Championship in Nagoya, Japan. The award is in memory of Prof. Silvia Coradeschi, a founding trustee of RoboCup, and is awarded to young female RoboCup students with distinguishing research. Padmaja joined the MAS program in September 2014 and has been an active member of the b-it-bots@Work since 2015. Her R&D project involved researching different types of sensors for grasp monitoring and eventually implemented one for the flexible fingers used on the youBot. She is the first student in Europe to win the award.

Prof. Lakemeyer Elected EurAI President

Congratulations to Prof. Gerhard Lakemeyer, leader of the Knowledge-Based Systems Group at RWTH Aachen's Chair of Information Systems and Databases, who was elected President of the European Association for Artificial Intelligence (EurAI), for the period 2016-2018. Professor Lakemeyer is part of the the highly successful robotics cluster that has been established in and around b-it.

MAS Alumnus Diego Ramos Avila Wins Thesis Prize

The MAS alumnus Diego Ramos Avila was awarded a prize for his research thesis by the Hochschulgesellschaft Bonn-Rhein-Sieg. The thesis, supervised by Prof. Paul Plöger and Prof. Alexander Asteroth, examines the application of swarm intelligence to the problem of motion planning for robots; in particular, the thesis compares the so-called grey-wolf optimiser (GWO) with two standard motion planning algorithms, namely rapidly-exploring random trees (RRTs) and probabilistic roadmaps (PRMs). The results of the thesis are quite promising and open the road to some more general questions, such as that of motion planning in multidimensional spaces.

Prof. Paul G. Plöger.

Prof. Jürgen Bajorath.

Padmaja Kulkarni with 2017 Silvia Coradeschi RoboCup Award.

Ramos Avila with award.

Events and Visits

Prof. Thomas Schultz

Prof. John. B. Brown, Kyoto University.

The RoboLand project was featured at BMBF stand at CeBIT 2017.

b-it Welcomes Thomas Schultz as new Professor

Thomas Schultz studied Computer Science at Saarland University with Medical Informatics as a minor with a prestigious scholarship of Studienstiftung des Deutschen Volkes. He continued his education obtaining his PhD from University of Tübingen in collaboration with the Max-Planck Institute for Intelligent Systems in 2009. He was awarded the Otto-Hahn-Medal of the Max-Planck Society for his outstanding doctoral thesis. After his doctoral graduation he joined the University of Chicago as a Postdoctoral Fellow, funded by the German Exchange Service (DAAD), in the same year. In 2011 he returned to the Max-Planck Institute in Tübingen as a postdoctoral researcher and changed to the University of Bonn in 2014.

In 2017 Thomas Schultz was awarded a b-it professorship jointly with the Institute of Computer Science at the University of Bonn. In the Life Science Informatics program he will contribute to strengthen the Visualistics module that focuses on medical imaging techniques. Professor Schultz will – among others – focus here on the presentation and interpretation of Magnetic Resonance Imaging (MRI) Data. He will also continue to teach Scientific Visualization in the Master Program of Media Informatics as well as teaching in the Institute of Computer Science at the University of Bonn.

RoboLand at CeBiT

RoboLand, which started in December 2016, is a BMBF-funded project whose objective is investigating the use of telepresence robots by people with dementia and their families. During the project, telepresence robots will be deployed in two remote regions in Hessen. Under the direction of Prof. Helma Bleses (Hochschule Fulda) and with the cooperation of FH St. Gallen (Switzerland) and TU Dortmund, the HBRS team, lead by Prof. Erwin Prassler

and research associates Argentina Ortega Sáinz and Maximilian Schöbel, explores the limitations and challenges of bringing telepresence robots to our everyday life.

Chemogenomics Workshop

Prof. John. B. Brown, Kyoto University, Japan, was the main presenter at the Chemogenomics Workshop on 22 and 23 August 2017 at b-it. He focused on the recent past of this young research area to highlight new developments such as the computational design of multi-target ligands. An outlook to future developments in the field and career advice for students complemented his presentations. Members of Prof. Bajorath's group contributed to the workshop with presentations of their current research. This workshop was extremely well received by the attending students who asked for a repeat of this workshop in the future.

b-it Lecture Series

Every year b-it holds its lecture series. Senior scientists from a Germany and abroad are invited to widen students' horizon by presenting their research topics. This year b-it was able to invite four alumni to deliver talks for the students. The alumni currently work in industry as data scientists (Haereus Medical, BASF SE) or in academia (Humboldt University Berlin, RWTH Aachen). Besides speaking about their current work, they also gave valuable insight into their respective career paths after obtaining their Master's Degree at b-it. This was very well received by the students who took the opportunity to ask many questions.

Dr. Priyanka Banerjee, Charité, with b-it students after her talk.
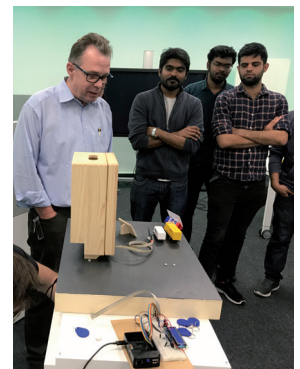
Research @ b-it

b-it Students Support Fraunhofer Blockchain Lab

Fraunhofer FIT has established an experience lab for blockchain technology. Several projects with industrial partners have been conducted in the context of this experience lab. The projects revolved around emerging service portfolios for industrial devices as well as monitoring of document flows in international trade businesses. Besides offering an experimental basis for industrial applications, the lab has also been deployed as teaching vehicle for practical lab courses by b-it students. One focus has been the use of smart contracts for machine-to-machine businesses. Smart vehicle control and replenishment of delivery boxes have been our illustrators. Imagine, an autonomous vehicle is travelling on a network of roads with toll collect, parking zones as well as re-charging and washing stations plus spots for passenger pick-up and drop-off. Each component in this scenario is acting as a technical agent with individual wallets for maintaining its credit balance. In principle, vehicles will be charged for using the road network and services consumed. In contrast, revenues can be generated by passenger transports. Communication and money exchange is fully automated and controlled by smart contracts.

Similar scenarios have been implemented for a delivery box at construction sites. Individual orders as well as pick-ups and potential returns can again directly be handled by smart contracts leading to a full automation of flexible supply chains. Both applications illustrate the potential of blockchain technology for machine-to-machine businesses.

ROPOD Project Commences

In the ROPOD project, which is a joint effort of Bonn-Rhein-Sieg University of Applied Sciences (HBRS), Locomotec GmbH, Agaplesion Markus Krankenhaus (all based in Germany), KU Leuven (Belgium), TU Eindhoven (Netherlands), and Speciaal Machinefabriek Ketels (Netherlands), the objective is to design and develop wheeled robots that can work together in order to transport various items in a hospital, such as beds, trolleys, and so forth. The project had its kick-off meeting in January 2017 and will run for three years. The HBRS team is lead by Prof. Erwin Prassler in cooperation with Prof. Paul Plöger, along with Santosh Thoduka, Alex Mitrevski, Maximilian Schöbel, and Argentina Ortega as research associates.

b-it-bots Summer Camp 2017

In September, the b-it-bots summer camp was organized by the MAS staff members Argentina Ortega, Santosh Thoduka, and Alex Mitrevski. Students of the MAS program got an opportunity to work on interesting projects in the context of industrial and domestic robotics. The summer camp had multiple objectives:

- introducing MAS students to our robots and the ongoing activities in the RoboCup@ Home and @Work teams,
- presenting various open problems in the domestic and industrial robotics domains and offering potential research topics that students can work on,
- helping students to get more practical experience with ROS development,
- encouraging rapid prototyping and deployment of code on the MAS robots.

Apart from having a chance to improve their skills, participants had also an opportunity to exchange experiences with MAS staff members and collaborate with experienced members of the @Work and @Home teams.

Fraunhofer Blockchain Lab b-it Prof. Thomas Rose with students.

Prof. Dr. Jan Borchers,
Media Computing

Prof. Dr. Thomas Rose,
Media Processes

List of employers of MI Alumni
(Universities & Research):
Airport Research Center GmbH, b-it, b-it Research School, Centro Nacional de Investigaciones Cardiovasculares, CERTH, Charité Berlin, Chinese Academy of Science, COSBI, Czech Technical, ETH Zurich, Fraunhofer FGAN, FIT, FKIE, FOKUS and IAIS, FSU Jena, Hasso-Plattner-Institut, HHI Berlin, Imperial College, INRIA, Institute of Molecular Medicine, Karlsruhe Institute of Technology (KIT), K. U. Leuven, Max Planck, Microsoft Research (Cairo), National University of Computer & Emerging Sciences, National University of Ireland Maynooth, National University of Sciences and Technology, Research Center Jülich, Robert Bosch Foundation, RWTH Aachen, Suez Canal University, Swiss Federal Institute of Technology, Uniklinik Aachen, Uniklinikum Bonn, Universidad Tecnologica de Panama, Universitätsspital Basel, University Clinic Carl Gustav Carus; Universities of Agder, Arab American Jenin, Asia and the Pacific, Atma Jaya Yogyakarta, Augsburg, Bahria, Bonn, Cambridge, Düsseldorf-Essen, Dresden, Duisburg-Essen, Edinburgh, Engineering & Technology Peshawar Pakistan, Ghent, Göttingen, Hamburg, Hasselt, Heidelberg, Houston, Oldenburg, Ireland, Maynooth, Ienes Kepler, Kiel, Leipzig, Mainz, Münster, Paris, Rotterdam, Sud, Stuttgart, Tilburg, Tirana, Toronto, Trento, Tübingen, Washington, Waterloo, Western Australia, West Indies, Zurich; TU Darmstadt, TU Dresden, TU Eindhoven, TU Munich

Master Program in Media Informatics

Computer scientists with an applied focus have been in great demand in the past, and this is expected to continue for the foreseeable future. Graduates of the Master Program in Media Informatics will be well-prepared for the challenges faced when working in computer systems engineering and for creative work with audio-visual media. The Aachen – Bonn – Cologne region is home to many prospective employers, including global players such as Philips, Microsoft, Telekom, Vodafone, Bertelsmann Group, as well as many television stations including RTL, WDR etc.

While a Bachelor degree in Computer Science typically qualifies to participate in large software projects, the Master degree provides the qualifications for project leadership. Graduates of the program in Media Informatics can be expected to be technically innovative, to work as system architects, and to manage large projects. Students who excel during their master program will also have the necessary qualification to pursue a doctoral degree in Germany or abroad.

The Master Program in Media Informatics educates the students to successfully meet the novel technical and economic challenges at the intersection of computer science, software engineering, next-generation communication systems, and the media. It is offered as a joint program of RWTH Aachen University and University of Bonn.

The program is characterized by a significant portion of lab courses embedded in research of the participating Fraunhofer Institutes for Applied Information Technology FIT and for Intelligent Analysis and Information Systems IAIS. The degree is conferred by RWTH Aachen University. Cooperation partners from industry and research contribute to a rich teaching program.

The course contents are structured according to the ECTS (European Credit Transfer System) and consist of three main blocks: Computer Science and its mathematical foundations, Multimedia Technology, and Media Science and business aspects. Major topics include: Internet Infrastructures, Data Communication, Digital Interactive Media, Management of Information, Computer Graphics, Animation, Visualization, Speech / Image / Video Processing, Game Design, Security and Cryptography, Designing Interactive Systems, Cooperative Work Environments, E-Business, Knowledge Management, Virtual and Augmented Reality, and Software Engineering.

Thirty three Media Informatics students have completed their degree in the academic year 2016-2017. The graduates quickly found interesting positions either as doctoral students in Germany and abroad, or in attractive companies. The incoming class of 2017 comprises 38 students, selected from 283 applications. The new students come from 15 countries, and include 39% females and 61% males.

News from Media Informatics Alumni

DR. PRAKAIWAN VAJRABHAYA

who is originally from Thailand, received her doctorate in Linguistics from the University of Oregon, U.S.A. She joined b-it in 2016 and teaches two courses in the MI MA-program: "Language, Mind, & Media" and "Communication in the Digital Age". The courses are geared towards grounding students with essential concepts from cognitive linguistics and communication studies, while providing opportunities to apply such knowledge to fit their individual interests. In her research, she primarily investigates the Repetition Effect in the production of speech and gesture. Collaborating with colleagues at the Natural Media Lab (HumTec) and the Center for Sign Language and Gesture (SignGes) of RWTH Aachen, she now employs Motion-Capture Technology to examine German Sign Language (DGS) signs under Repetition.

JIYONG AN

One of Dr. Vajrabhaya's b-it students, Ms. Jiyong An, recently joined the group as a research assistant. She is an asset to the DGS project, for she brings in her programming skills to help create a computational model of DGS signs. Ms. An received her B.Sc. in Computer Science & Engineering, as well as a double B.A. in Psychology and Digital Humanities from Ewha Womans University, Seoul, South Korea. Her motivation to join the b-it Media Informatics program was to learn from internationally renowned scholars how to achieve fundamental changes in user experience regarding seamless and natural human-computer interaction.

Eliza Koshtoyan

Thanks to the interesting courses and innovative projects accomplished during my studies at MI, I obtained vast knowledge and practical experience in fields of Software Design and Development, Human Computer Interaction as well as different fields of applied mathematics. This experience enabled me to participate in international workshops held by global institutions like Google and ETH Zurich. Furthermore, in 2016 I was awarded a scholarship to participate in "Grace Hopper Celebration for Women in Computing" annual conference in US. I also got an opportunity to apply my knowledge in industry by being selected for a master's thesis position at SAP. After successful completion of my thesis, I was offered a Software Developer position at SAP.

Media Computing's Haptic Vest at BMBF

Haptic Vest 2.0 is a wearable vest that renders depth images from a front-facing camera onto the wearer's torso using an array of vibration motors, enabling people with vision impairments to avoid obstacles while walking. The Media Computing group of Prof. Jan Borchers demonstrated the Haptic Vest 2.0 at the Open House Event of the Ministry of Education and Science (BMBF) as one of four examples of the new high-tech strategy of the federal government. Haptic Vest 2.0 was also featured on the BMBF home page and in several TV reports in summer of 2017.

Prof. Dr. Jürgen Bajorath,
Life Science Informatics

Prof. Dr. Martin
Hofmann-Apitius, Life
Science Informatics

**List of employers of
LSI Alumni (Business):**

*4GATC Biotech, Accenture,
Asahi Kasei, ASI Data Science,
Astra Seneca, BASF SE, Bayer,
BenevolentAI, Ericsson,
carpooling.com GmbH, Clue
Points, Comma Soft AG, Coty
Germany, Curetis, ecSeq
Bioinformatics, Freeletic,
Galileo Press, GAMOMAT
Development GmbH, GATC
Biotech, Genestack, Glaxo
Smith Kline, Hamilton
Medical, HealthCare Global,
Heraeus, Hoffmann-La
Roche, Hype Innovation,
IBM, IIT Bangalore, ITTM
S.A., Interpretomics, Land of
Lakes Inc., Leaf Bioscience,
LHS Telecommunications,
LinkTechnica, L'Oréal,
MarAnCon, Max Dellbrück
Center Berlin, Molecular
Health GmbH, Medtronic,
Molecular Connections
Private Limited, Merck,
Monsanto, msg systems ag,
Nestlé Institute of Health
Science, Novartis, Omnicom
Media Group, Pfizer,
parlamind GmbH, Postbank,
Philips Research North
America, ProfileXpert, quintly
Inc., real.digital, Syngene
International Limited, United
Brands Marketing, Tubs
System LLP*

Master Program in Life Science Informatics

The Master Program in Life Science Informatics (LSI) is offered by the University of Bonn and RWTH Aachen University in cooperation with the Fraunhofer Institutes of Scientific Computing (SCAI) and Applied IT (FIT). The degree is conferred by the University of Bonn. This interdisciplinary program educates the participants to successfully master the novel technical and economic challenges at the crossroads of biotechnology, medicine, pharmaceutics and computer science. The curriculum consists of three main blocks: Computer Science and Mathematics for life scientists; Basic principles of Life Science Informatics; Biology of the cell and systems biology.

Major topics include biomedical database systems, data mining and machine learning, statistical genetics, drug design, medical imaging and visualization, computational neuroscience, computational modeling of regulatory and metabolic networks, chem-informatics, bioinformatics, molecular modeling, molecular biology, pharmaceutical chemistry, biotechnology and systems biology. The program emphasizes a profound understanding of biological structures (such as proteins, nucleic acids, genes, metabolic, neural networks and organisms) as well as the appropriate application of methods of computer science to this field. It also includes training designed to sensitize students to the ethical implications of emerging biotechnologies. This combination will enable the successful students to understand biological or medical problems and to find appropriate and valid solutions that bioinformatics can offer. The program is characterized by a significant share of research lab courses embedded in both basic and applied research of the participating Fraunhofer Institutes as

well in labs of CEMBIO (Center for Molecular Biology) and LIMES (LIfe and MEdical Sciences Research Biocenter Bonn). The final six months of the program are dedicated to the master thesis which can be done in cooperation with industry.

Graduates of the program are well prepared for the typical professional tasks in applied data analysis, systems biology and data modeling, in industrial functional genomics, drug design and pharmacology. The Aachen-Bonn-Cologne-Düsseldorf region is home to many prospective employers, including excellent academic institutes and research driven companies. The regular and well attended meetings of the LSI Series "The ABC of Life Science Informatics" in the last years have contributed to strengthen ties with scientists of the region. Several interesting master thesis have been carried out in collaboration with them. LSI students were also instrumental in this process. This has increased the visibility of the program considerably, also on a larger geographical scale.

This year 17 students successfully graduated from the program. Top students received excellent placements again. They were, for example, accepted into PhD Research Schools at the University College London (UCL), Berlin Institute of Health, European Molecular Biology Laboratory or at research departments and institutions of companies such as: BASF SE, msg systems ag or Nestlé Institute of Health Science. More than 30 new students from countries ranging from A (like Armenia) to Y (like Yemen) from a total of 21 different countries will take up their studies in Winter Semester 2017/2018 selected from 141 applications.

LSI Success Stories

ALPHA TOM KODAMULLIL

obtained a Bachelor's Degree in Biotechnology from Vinayaka Mission's Research Foundation in Tamil Nadu, India, when she joined the Master Program of Life Science Informatics in 2010. She completed it 2012 with a Master thesis carried out in Prof. Hofmann-Apitius's group. She continued her education in the same group by starting her PhD work in 2013. Alpha is currently finalizing her PhD thesis; with an overwhelming output on high-ranking scientific publications. Currently, she has a first author research paper in press entitled "Tracing investment in drug development for Alzheimer disease" which will appear in Nature Reviews Drug Discovery. In the course of her PhD work, Alpha has contributed substantially to the overall success of IMI project AETIONOMY. Moreover, as a PhD student (!) she has negotiated, planned and conducted three collaborative research projects in the area of psychiatry for the US-based, private "Cohen Veterans Bioscience" foundation.

ANTONIO DE LA VEGA DE LEÓN

obtained a Bachelor's Degree in Biology from the University Complutense in Madrid in 2010 when he joined the Master Program of Life Science Informatics in October 2010. He carried out his Master Thesis in Prof. Bajorath's group and received his Master's Degree in 2012. Antonio continued his education in Professor Bajorath's group and graduated with a PhD in October 2016. In November 2016 he joined the University of Sheffield Information School as Marie Curie Fellow. In May 2017 he was awarded the Bayer Promotionspreis (Bayer PhD award) for his PhD thesis.

SHWETA BAGEWADI KAWALIA

joined the master Program of Life Science Informatics with a Bachelor's Degree in Biotechnology from Sir. M Visvesvaraya Institute of Technology, Bangalore, India, in 2007. After studies she was offered a position as Programmer Analyst at Cognizant Technologies, Bangalore. She left Cognizant in 2009. She started her studies in Life Science Informatics in October 2009. During her studies she did an internship at Merck Serono, Darmstadt, and obtained her Master's Degree in Life Science Informatics in 2012. She continued her education in the group of Prof. Hofmann-Apitius and worked between 2012 and 2016 on her PhD thesis. In 2016 she took one year of maternity leave and submitted her PhD thesis in September 2017. Starting October 2017, she will join BASF (the Chemical Company in Ludwigshafen, Germany) as a Data Scientist.

THOMAS BLASCHKE

joined the Master Program of Life Science Informatics in 2014 after he obtained a Bachelor's Degree in Molecular Biomedicine from the University of Bonn. For his Master's thesis he joined Prof. Bajorath's group at b-it and obtained his Master's degree in 2016. He continued his education for PhD in a collaboration of Prof. Bajorath's group and the pharmaceutical company AstraZeneca as a Marie Skodowska-Curie scholarship holder within the BIGCHEM graduate school. There, he works on "Accessing new chemical space for lead optimization based on QSAR models".

Prof. Dr. Gerhard Kraetzschmar,
Autonomous Systems

Prof. Dr. Paul Plöger,
Autonomous Systems

Prof. Dr. Erwin Prassler,
Autonomous Systems

b-it Programs

Master Program in Autonomous Systems

The Master's program in Autonomous Systems is an international program, taught entirely in English, offering multi-faceted training in the fields of robotics and artificial intelligence. Various robot platforms are used for educational and research purposes, including the Care-O-Bot 3, and the youBot. The focus is on enabling and integrating the necessary intelligence behind the autonomous behavior of artificial agents rather than on the hardware-related aspects of robotics. Students get a solid theoretical background in autonomous mobile robots, advanced control methods, robot manipulation, learning and adaptivity, hardware-software co-design of embedded systems, probabilistic reasoning, and planning and scheduling. The courses are combined with research work conducted at the Fraunhofer Institute for Intelligent Analysis and Information Systems (IAIS) and other partner institutions.

Students take a number of core courses in the first semester as well as compulsory seminars, and practical courses throughout their studies. The Winter Semester 2012 saw the first students study under the new curriculum, which received ASIIN accreditation in April 2012. In addition to the accreditation certificate from the German Accreditation Board, the program got the special ASIIN accreditation label and the Euro Inf Label from the European Quality Assurance Network for Information Education (EQANIE). Students now choose one of two tracks to specialize in at the end of their first semester: the Intelligent Robots track and the Robot Systems Design track.

In the academic year 2016-2017, 37 students joined the MAS program from an applicant pool of 518 candidates. The MAS program has always attracted the interest of students all over the globe. The 13 different nationalities of the 37 students who joined the program in the 2016-2017 academic year is proof of this fact.

The program is offered by the b-it Applied Science Institute (b-itAS) in the Department of Computer Science at the Bonn-Rhein-Sieg University of Applied Sciences (BRSU). b-itAS cooperates closely with the Fraunhofer IAIS in implementing the program, which started in the winter of 2002. Two dual degree programs exist with both the University of New Brunswick in Canada and the German-Jordanian University in Amman, Jordan.

The program is managed by three professors (Gerhard Kraetzschmar, Paul G. Plöger and Erwin Prassler), three research associates (Iman Awaad, Anastassia Küstenmacher and Nico Hochgeschwender) as well as researchers who have been recruited through the RockEU2, EmoRobot, ROPOD and RoboLand projects (Rhama Dwiputra, Matthias Füller, Alex Mitrevski, Alexander Moriarty, Argentina Ortega, Sven Schneider, Maximilian Schöbel and Santosh Thoduka).

The faculty and staff are actively involved in many scientific activities, including memberships in technical committees of IEEE or in the RoboCup Federation trustee board, the euRobotics aisbl board, numerous program committees of workshops and scientific conferences such as IROS, ICRA, ICAR, ICMA, and AAMAS.

MAS Success Stories

BEATRIZ LEÓN

*Software Developer
The Shadow Robot
Company,
London, UK*

Studying my masters in Autonomous Systems at HBRS was an amazing experience giving me all the foundations for the next steps in my career. After finishing my master's, I did my PhD focusing on simulation, studying robot grasping and comparing it to the human grasp. Later, I went back to London working as a postdoc at the University of Hertfordshire. Wanting industrial experience, I then got a job as a software developer at the Shadow Robot Company, a company famous for producing the most dexterous hand in the world. I am involved not only in developing the software for the robot hands, but also participating in different research projects with a wide range of applications such as agriculture, surgery, tele-operation or robot home assistants.

LIZA SPIEVA

*Chief Engineer, PhD
student, Robotics
Corporation, Moscow,
Russia*

At the moment I am a professional working in the company Robotics Corporation. I am a chief engineer combining a project management position and development for various industrial and domestic robots such as the Baxter. I completed my M.Sc. in Autonomous Systems at HBRS. I had the opportunity to be involved in the RoboCup championships, which helped me gain not only technical knowledge, but useful communication skills and skills needed to solve challenging problems under stressful conditions. Moreover, the experience of living and studying in a foreign country gave me an opportunity to gain cross-cultural competences as well. Having missed research and gotten industrial experience, I have now also started my PhD work back home in Russia.

SASI KIRAN GADE

*CEO, Gade Autonomous
Systems Private Limited;
Research Head, Center
for Robolution; Director,
Innovations Payments
Services Limited*

When I was a kid, I dreamt of becoming a gamer, engineer, astronaut, actor, artist, lawyer, psychologist and, of course, to be GOD himself. Luckily, I became an engineer. My transition from a computer science engineer to a roboticist happened at HBRS. There, I was introduced to Human Robot Interaction and then combined that with my hobby "philosophy". It is because of this experience and guidance from my professors that taught me the German way of doing research and problem solving, due to which my company Gade Autonomous Systems has been rated as one of Top 10 Robotic Companies in India for 2016. I was so fond of this experience that I named my first company after the course "Gade Autonomous Systems".

MATIAS VALDENEGRO

*Marie Curie Fellow,
Heriot-Watt University*

I really enjoyed my time during MAS. This program gave me the fundamentals of research in robotics, which I am applying during my PhD in Underwater Robotics. Courses I took during MAS have been very useful for my doctoral research. I am currently a Marie Curie Fellow at Heriot-Watt University, and also a guest researcher at the German Research Centre for Artificial Intelligence. I will complete my PhD soon and I am already looking for jobs in Germany.

List of employers of MAS Alumni *(Business):*
Ableton, ASIMOV Robotics, Banksoft, BMW cyber:con GmbH, Delphi, Exciera Technologies, Faro GmbH, Gade Autonomous Systems Private Limited, Google/Alphabet, GPS, IBM , Ingen Robotics, Kuka Robotics, M2P Consulting, MesaX, Rapyuta Robotics, RBOT, Robots Alive Consulting, Shadow Robot Company, Siemens, Systemantics India, The MathWorks, Trivago, VMware

List of employers of MAS Alumni *(Universities & Research):*
DLR, Fraunhofer FGAN, Fraunhofer IAIS, Freie Universität Berlin, Heriot-Watt University, Hochschule Bonn-Rhein-Sieg, Hochschule Bonn-Rhein-Sieg (Graduate Institute), Hochschule Bonn-Rhein-Sieg (Institut für Sicherheitsforschung), Instituto Superior Técnico (IST) - Universidade de Lisboa, Jacobs University LAAS-CNRS, Örebro University, Osnabrück University, Rhine-Waal University of Applied Sciences, RWTH Aachen, TU Wien, TUBITAK-UZAY Space Technologies Research Institute, Universidad Anáhuac Mayab in Mérida, University Jaume I, University of Erlangen, University of Hertfordshire, University of Louvain, University of Western Australia

International Program of Excellence in Computer Science

Prof. Dr. Stefan Kowalewski, Embedded Systems

Prof. Dr. Christian Bauckhage

The International Program of Excellence in Computer Science (IPEC) at b-it offers compact courses primarily during the semester break and at the highest educational level. This results in faster studies and advanced quality in selected subject areas. These courses apply to a limited number of highly qualified students of the University of Bonn, the RWTH Aachen University and, in the future, other German or foreign universities. Undergraduate IPEC courses are planned in a way that the time required for the bachelor degree will be reduced up to one year.

Additionally there are cross-cutting courses that accelerate the master studies at the b-it as well as regular summer and winter schools that are designated for selected topics of computer science. These courses are held in cooperation with international guest scientists. Applications of foreign students are welcome.

The expected impact of the Program of Excellence is not limited to a significant acceleration of undergraduate and graduate studies in conjunction with an international visibility. It also brings together outstanding students with internationally noted scientists and with fellow students from abroad and activates new forms of encouraging competition among students. The IPEC courses usually comprise a mix of lecture classes, seminars, and lab courses, such that students can make best use of the compressed time schedule. Currently, this part of the program is being restructured as to provide an „honors class" supplement to the top 10% bachelor students in Aachen and Bonn, loosely linked to the NRW public-private scholarship programs the Ministry of Innovation has initiated for this group of students.

Excellence in Big Data Analytics

The b-it partner universities are among the leading German, even European, organizations in the field of Data Science, Data Engineering, and Machine Learning. For example, the three Fraunhofer institutes at Birlinghoven Castle coordinate the Fraunhofer Big Data Alliance, have started the international Industrial Data Space Initiative aiming at more data sovereignty in business, and lead numerous national and European projects in this rapidly expanding field.

One of the key results of the b-it Evaluation in 2015-2016 was the decision to strengthen this aspect also in the b-it teaching offers. While the b-it mission statement already rightly emphasizes the role of data science and AI aspects in all three existing b-it Master Programs, we also consider further strengthening these topics in our teaching.

In preparation for this move, it was decided to dedicate the currently vacant b-it full professorships formerly filled by Prof. v.z. Gathen explicitly to the field of Data Science. In 2017, an intense faculty search resulted in several excellent candidates; we expect to be able to report on the resulting hiring in our next annual report.

The new colleague, as well as future b-it students, can expect an even more exciting research context than now, as the rather small team of b-it faculty could become one of the most successful groups in the present German Excellence Competition: five of their excellence cluster proposals – all topically related to b-it study programs – are among the 88 out of originally 195 proposals that reached the final full proposal stage.

Schüler-Krypto 2017

On two days in March 2017, 157 high school students as well as nine teachers met for the sixteenth Schüler-Krypto to learn@bit on secret messages, encryption and decryption. They came from Bedburg, Bingen, Bonn, Bornheim, Hennef, Königswinter, Neunkirchen-Seelscheid, Neuss, Neuwied and Sankt Augustin.

With a welcome by Prof. Dr. Stefan Wrobel and after an introduction to the topic by Michael Nüsken the students got to the nitty-gritty. Everybody was asked to take up the role of James Bond and program RSA on the laptop built-in to Bond's BMW Z8. We used Sage on it, a free open-source computer algebra system which among many other things is capable of calculating with arbitrarily large numbers. The students sent emails to Moneypenny and decrypted answers from her, set up a public-key infrastructure and exchanged encrypted messages with each other. As a sidetrack, in a game-like setting the students could experimentally find out how the main step in the encryption and decryption of RSA, namely the modular exponentiation, can be executed in a jiffy. And finally, everybody could take home her personal VisKy (visual cryptogram).

Other glimpses of computer science were presented in the lunch break. The laser and light show again presented by Matthias Frank from the laser and light lab fascinated pupils and teachers. Moreover, he also provided answers to questions and material on study programs at b-it and university.

In the outro Thomas Stasch, Civitec and ProKoSi, and Werner Koch, head of g10code, the company that produces the public-domain tool GnuPG, gave insights into real world business. On the one hand side, Werner Koch represents the personal, individual view of each of us for a free and open world and on the other side, Thomas Stasch serving government and town halls acts between state rules and basic law and rights.

Bond's Thursday crew.

On Bond's tracks.

b-it Universities Institute

ABC – three letters that stand for a veritable "magic triangle": the region between Aachen, Bonn and Cologne, which is not only economically strong, but also a leader in science, education and research. The large number of research establishments based here make the area one of Europe's biggest and most important science landscapes. Almost 10 percent of all German students – around 130,000 people – are studying at the Rheinisch-Westfälische Technische Hochschule in Aachen, the Rheinische Friedrich-Wilhelms-Universität Bonn and the Universität zu Köln, which together constitute one of the most important higher education locations in Europe. The three ABC institutions are closely linked and collaborate in many fields of teaching and research.

University of Bonn

The University of Bonn is a research-oriented university with currently about 35,600 students. Its research tradition of 200 years is closely linked to the names of Hermann von Helmholtz, Heinrich Hertz and Friedrich August Kekulé who carried out seminal work at the University of Bonn. This strong academic tradition has been continued until present with the more recent Nobel laureates Wolfgang Paul and Reinhard Selten. Bonn cooperates with numerous other universities and research institutions around the globe. The specializations it has developed enjoy worldwide recognition. More than 5,000 students from 130 countries are enrolled in Bonn. Their presence underlines the international character of the university and enriches both academic and social life in Bonn. Living up to its long tradition as a classical university with a full range of academic disciplines, the University of Bonn offers nearly a hundred different first degree programs. Students can choose from a wide and modern spectrum of subjects that allows a multiplicity of combinations.

RWTH Aachen University

RWTH Aachen University was founded as a Polytechnic in 1870 with considerable support from local industry. In 1948 it was established as Rheinisch-Westfälische Technische Hochschule Aachen (RWTH), the Institute of Technology of the State of North Rhine-Westphalia. Today, RWTH is one of the most renowned technical universities in Europe with around 44,500 students. RWTH offers 152 courses of study (undergraduate and postgraduate). The RWTH master programs educate engineers who are keen to engage in R & D, innovation, and entrepreneurship. In 2007, RWTH Aachen was elected as one of nine "elite universities" within the German excellence program. In the current Times Higher Education Ranking, RWTH Aachen University is placed 78th among the several thousand evaluated universities. Aachen's Computer Science department, as the direct partner in b-it, even achieved rank 29 worldwide.

The spacious Hofgartenwiese is a major summer attraction on the University of Bonn campus.

Entrance of Birlinghoven Castle.

The Birlinghoven Castle campus is one of the largest and most influential computer science research sites in Germany. About 500 researchers work in the IZB institutes. That represents a quarter of the Fraunhofer ICT Group, Europe's largest IT research organization. The institutes collaborate closely with the European ERCIM network of national IT research centers as well as with leading research establishments in the USA, Eastern Europe and Asia. Three IZB institutes contribute to the b-it master programs Media Informatics and Life Science Informatics:

Fraunhofer FIT

FIT, the Fraunhofer Institute of Applied Information Technology, investigates human-centered computing in a business or engineering process context. The usability and usefulness of information and cooperation systems is optimized in their interplay between human work practice, organization and process. In Life Science Informatics the institute focuses on protein analysis, visual support for navigation in micro surgery, and assistive information technology. In Media Informatics innovative information visualization systems, mixed and augmented reality environments for industrial planning, pervasive gaming applications, and value chains for public-sector information services are main research topics.
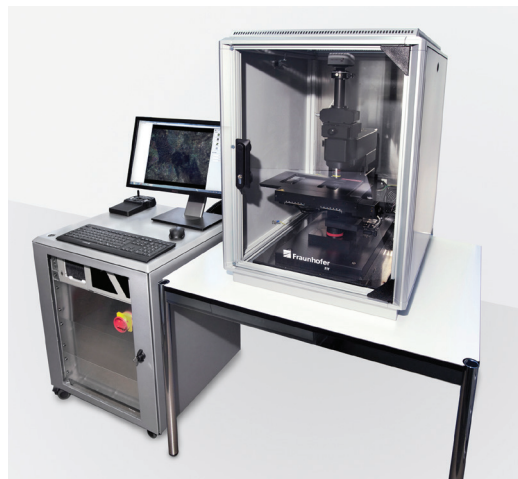

TopoScan microscope of Fraunhofer FIT: TopoScan is a modular hardware-software platform for the automated high content analysis of biological samples. Its unique software-driven architecture combines two properties within one system: Streamlined workflows with minimal intervention for the reproducible acquisition and analysis of high content assays.

Fraunhofer SCAI

The Fraunhofer Institute for Algorithms and Scientific Computing SCAI conducts research in the area of computational science and is a valued corporate partner for industry and academia. SCAI designs and optimizes industrial applications, implements custom solutions for production and logistics, and employs high-performance computers. The Department of Bioinformatics at Fraunhofer SCAI carries out applied research and development in three areas:

1. Techniques for information extraction in the life sciences, including recognition of named entities and relationships in text as well as large-scale, automated information extraction.
2. Integrative biology, with a particular focus on modeling neurodegenerative diseases.
3. eScience, Grid and Cloud Computing as well as technologies for the operation of HPC (Clusters) with a focus on SLA, security, and license management.

The Department of Bioinformatics is partner in major funded projects at national and EU level. Software tools for information extraction developed at SCAI BIO are used in the vast majority of pharmaceutical companies worldwide.
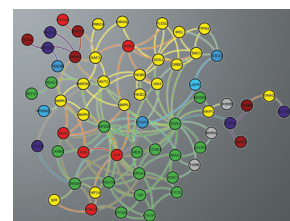
Fraunhofer SCAI: A hormonal network underlying dementia and Alzheimer's disease.

b-it Applied Science Institute

Bonn-Rhine-Sieg University of Applied Sciences (BRSU)

Founded in 1995, the Bonn-Rhine-Sieg University of Applied Sciences significantly extends the range of applied research and teaching in the greater Bonn area. It specializes in business administration, natural sciences, engineering and computer science, strongly encouraging cooperation with industrial partners and a focus on use-driven and interdisciplinary research and teaching.

The three campuses at Sankt Augustin, Rheinbach and Hennef are well equipped with modern laboratories, studios, workshops and facilities for cooperative research. By 2017, the different departments accommodate more than 8,000 students.

The Department of Computer Science offers a Bachelor and a Master program in Computer Science and in cooperation with the Departments of Business Administration a Bachelor program in Business Information Systems. The Master program Autonomous Systems is offered by the b-it Applied Science Institute, a cooperation between the Department of Computer Science and the Fraunhofer Institute for Intelligent Analysis and Information Systems IAIS.

Campus of the Bonn-Rhine-Sieg University of Applied Sciences.

Fraunhofer IAIS

The Fraunhofer Institute for Intelligent Analysis and Information Systems IAIS develops tailor-made IT solutions to support companies and organizations optimize products, services and processes, as well as to implement intelligent information management. There is a particular focus on the analysis, access and targeted use of Big Data, new media technologies and solutions for innovative business and security processes.

In order to support customers in their information management and decision-making processes, the scientists use innovative technologies such as knowledge extraction, visual analytics and data mining to provide them with holistic analyses of large amounts of data. Semantic and adaptive media applications open up new possibilities for linking data and knowledge and for making them accessible via the Internet. By utilizing business intelligence solutions the Fraunhofer IAIS team is able to optimize its customers' business, IT and security processes and so improve their business success. The institute's research and development activities are defined by the business areas Big Data Analytics, Business Modeling & Analytics, Content Technologies & Services, Enterprise Information Integration, Image Processing, Intelligent Media & Learning, Marketing, Market Research & Media Analysis and Preventive Security. Fraunhofer IAIS and its 230 strong team combine in-depth industry knowledge with expertise in a full range of technical disciplines, most notably computer science but also mathematics, natural sciences, business management, geo sciences and social sciences.

General Information

General Admission Requirements

- A first university-level degree (B.Sc., B.Eng.), as specified for the individual programs, with grades well above average is required. The Graduate Record Examination (GRE) is strongly recommended;
- All courses are held in English, thus fluency in English in vital. It is evaluated on the basis of TOEFL 550 paper-based, 213 computer-based, or IELTS 6.0;
- Working knowledge of German is necessary to take up some of culture that the Aachen – Bonn – Cologne region has developed over the last 2,000 years. Therefore, a basic German language course is offered before start of the program and during the first year.
- Admission is coupled to placement in the Fraunhofer lab courses and therefore strictly limited. Application deadline has been March 1 for Fall admission but may change from year to year; check www.b-it-center.de for current admission details.

Fees and Finances

As of 2017, a student union fee of ca. 270 € per semester covers student activities, subsidized meals, and free public transportation in the whole state of North Rhine-Westphalia.

A student's monthly expenses, including study material, will be about 800 €. b-it does not offer formal scholarships but several student assistantships are available on a competitive basis. For information on funding from German sources please contact the DAAD – German Academic Exchange Service www.daad.de.

Studying in Bonn

Most of the teaching in b-it is concentrated in Bonn and its eastern neighbor, Sankt Augustin. Newcomers to Bonn soon grow very fond of the city – a fact confirmed by thousands of students and academics, German and foreign, who have come here to learn, teach or research. Since the German Bundestag moved its seat and parts of the Federal Government to Berlin in 1999, Bonn attracted a number of international organiza-tions, especially United Nations bodies, and some major corporations. Among others, Deutsche Telekom and Deutsche Post have their headquarters there. Now Bonn is evolving into an internationally recognized science region – with the university as one of the dynamic forces driving this change. In addition, Bonn offers a wide variety of attractions and amenities. The city's most famous son, Ludwig van Beethoven, is the star attraction of a lively and varied arts and culture scene. The city boasts an opera house, several theatres, concert halls and other venues, as well as a range of fascinating museums.