ANNUAL REPORT 2017

BRNO UNIVERSITY OF TECHNOLOGY
FACULTY OF INFORMATION TECHNOLOGY


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Brno University of Technology
2018

Božetěchova 1/2, Brno 612 66

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Foreword by the Dean

The year 2017 was the sixteenth year of the existence of the Faculty of Information Technology. For people, sixteen is a wild age, but the faculty has been quite mature for a while now. It is known to be a significant part of Brno University of Technology and a place where information technology and its application is taken seriously, where students and researchers are offered great conditions for their work and where social life and good spirits thrive. Indeed, everyone can make their own opinion on that on the basis of this annual report.

I would like to thank everyone involved in the faculty's development for their work. We do not take the successful development of the faculty for granted, as it is the result of hard work of many people, both from among its employees and students, which make the faculty what it is.

The year 2017 was distinct because we needed to significantly change practically all of our basic documents due to the new Act on Higher Education Institutions. Unfortunately, other changes in the legal environment (such as the contracts register, procedures within administrative proceedings, and document circulation) meant more bureaucracy or us, too. Let us hope that we can tackle the red tape in the future rather than being too overwhelmed by it. That will be our task for 2018.

Pavel Zemčík
Dean

FIT profile

Faculty of Information Technology

a renowned institution that offers top quality education and excellent research

The Faculty of Information Technology is a modern, internationally renowned university institution, and a centre of top quality research in various areas of IT – from hardware, through intelligent systems to multimedia. At its modern and uniquely equipped campus, the faculty offers to its students highly valuated education in IT at all levels of studies: the three-year Bachelor's programmes, the two-year follow-up Master's programmes, and the four-year Doctoral studies.

Science and research

There are over twenty research groups working at the faculty, many of them being successful not only in the Czech Republic, but also abroad. FIT is participating in both national and international projects – whether on its own or in co-operation with other universities, research centres, or renowned companies and institutions. The faculty also operates its own Research Centre of Information Technology. The centre is part of the IT4Innovations centre of excellence, the owner of the national supercomputing centre.

Tradition

The faculty's tradition of teaching information technology started in 1964, when the Department of Automatic Computers was established at the Faculty of Electrical Engineering of the Brno University of Technology. The department grew gradually, and became a faculty in 2002. Today, almost 2,500 students attend.

Teaching and practice

The faculty emphasises high quality theoretical preparation corresponding to university studies in the field of technology. However, we realise the importance of the studies being interconnected with practical experience. The faculty has its own Industrial Board through which it maintains regular contact with the industry leaders. That allows the faculty to bring the latest findings from practice into its study programmes. As a result, FIT graduates are highly demanded at the labour market, and have the highest starting salaries from all BUT graduates.

Campus

The faculty's campus is a unique combination of carefully renovated historic premises of the former Carthusian monastery from the 14th century and new and modern buildings.

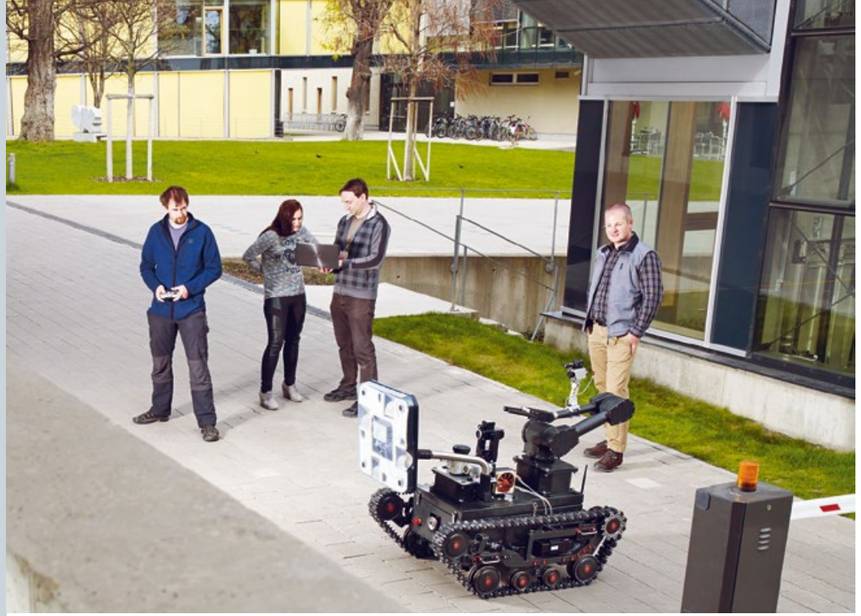
The renovation and construction works were carried out between 2006 and 2013, giving the leading Brno architects an opportunity to utilise the most recent findings on creating university teaching areas.

The premises consist not only of lecture rooms and laboratories equipped with state-of-the-art technology, but also provide space to relax and rest in, dining areas, and a space for cultural and leisure activities.

Strategic goals

STUDIES AT FIT

The Faculty of Information Technology will continue in development of its study programmes and offers. That way, we can maintain the quality and relevance of the courses and good career opportunities for our graduates in the long term. With the kind support of the South Moravian Region and using the research infrastructure, we will try to increase the number of students in connection with the requirements of employers. Finding the resources to fund the increase in the number of students where the standard methods of financing by the Ministry of Education, Youth and Sports fail will be a challenge we intend to tackle with the helping hand of the Regional Authority and employers.



FACULTY PRESENTATION

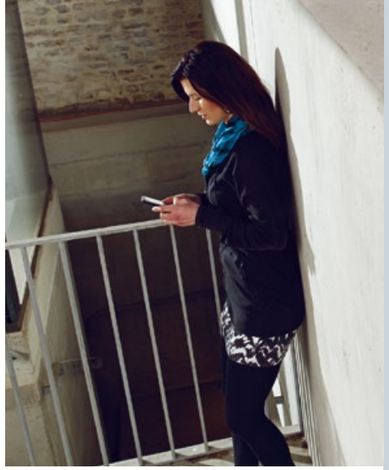
FIT BUT will promote its activities with the objective to strengthen its good reputation and image among both professionals and the public. It will support the marketing and promotional activities and the development of marketing strategies of BUT in order to ensure that it attracts the most talented applicants. The faculty will create the position of a marketing specialist, revise its web presentation so as to reflect the new visual style of BUT and its technical development, and continue to support and extend the presentation of the faculty on social media.

INTERNATIONAL RELATIONS

We will also support international relations, including study stays of both students and academic staff abroad and in the industry, as well as the integration of foreign professionals into the faculty's departments. We will also gladly accept foreign visiting students. We will also introduce a study programme taught in English, and seek new liaisons, particularly with renowned technology-oriented universities, with the view to co-operate in research, and also in student exchange and implementation of joint study programmes (double, or even joint degree).

EXCELLENT RESEARCH AND APPLICATION OF ITS RESULTS

The faculty will support and develop meaningful and top quality research activities in the field of applied research, which has been particularly focused on the local industry, in the basic research that impacts the future use of information technologies, and also in industry research and development when necessary for achievement and maintenance of good quality and co-operation. We will strive for additional, external research project funding, but will only pursue those projects that are in line with the faculty's focus and will not lead to unrealistic or unsustainable commitments. We will try to apply the result of our science and research activities in practice, and to use them actively, such as by establishing spin-off companies.



HUMAN RESOURCES

The faculty will support further education and professional development of its staff, including traineeships in practice. It will also continue to involve students, in particular doctoral students, into research projects in accordance with the BUT strategy, and will focus on financial rewards for outstanding and talented people.

2017 at FIT in numbers

2 306 students

200 courses taught

over **60** projects

240 publications

31 products

1 prototype

40 industry partners

100% success rate of the graduates finding a job

Faculty Management

Dean
prof. Dr. Ing. Pavel Zemčík

Vice-dean
for Bc. study
Ing. Bohuslav Křena, Ph.D.

Vice-dean
for MSc. study
doc. Ing. Richard Růžička, Ph.D., MBA

Vice-Dean
for Research
prof. Ing. Tomáš Hruška, Csc.

Vice-Dean
for External Relations
Ing. Vítězslav Beran, Ph.D.

Secretary
Ing. Petr Hajduk

Chairman
of the Academic Senate
of the FIT
prof. Ing. Lukáš Sekanina, Ph.D.

Chairman
of the Scientific Council
of the FIT
prof. Dr. Ing. Pavel Zemčík

Chairman
of the Disciplinary
Committee of the FIT
doc. Ing. František V. Zbořil, Csc.

Heads of departments and centres

Head of the Department
of Information Systems
doc. Dr. Ing. Dušan Kolář

Head of the Department
of Computer Systems
prof. Ing. Lukáš Sekanina, Ph.D.

Head of the Research
Centre of Information
Technology
prof. Ing. Tomáš Hruška, Csc.

Head of the Department
of Intelligent Systems
doc. Dr. Ing. Petr Hanáček

Head of the Department
of Computer Graphics
and Multimedia
doc. Dr. Ing. Jan Černocký

Head of the Computer
Centre
Ing. Petr Lampa

FIT representatives in the BUT Academic Senate

doc. Dr. Ing. Petr Hanáček
Chairperson of the BUT Academic Senate

doc. Ing. Jiří Jaroš, Ph.D.
member of the Chamber of Academic Staff
of the BUT Academic Senate

Ing. Radek Hranický
Vice-chairman of the Student Chamber
of the BUT Academic Senate

Number of employees in 2017

56 academics
58 researchers
57 technical and economic staff
18 manual workers

Recognition and awards in 2017

Award of the President of GACR

In September, Professor Lukáš Sekanina accepted the Award of the President of GACR for his work on the project titled Advanced Methods of Evolutionary Design of Complex Digital Circuits. The objective of the project was to create new methods of optimisation for circuits that are important in computer architecture, based on an evolutionary design. The methods are currently the most advanced on a global level.

◀ **Professor Lukáš Sekanina accepted the Award of the President of GACR.**

Photo: IFP

▲ **The awards was presented to Jakub Sochor by Professor Jean-Marie Lehn, the Nobel Laureate in Chemistry.**

Joseph Fourier Prize presented by a Nobel Prize Laureate

Jakub Sochor, our doctoral student, was awarded the Joseph Fourier Prize for computer sciences and informatics for his project titled Automatic Traffic Surveillance: Fine-Grained Recognition of Vehicles and Automatic Speed Measurement. The official awarding of the Prize took place on 16 June 2017 at the Buquoy Palace, the seat of the French Embassy, in the presence of the Ambassador of France to the Czech Republic. The awards were presented to the laureates by Professor Jean-Marie Lehn, the Nobel Laureate in Chemistry for 1987.

Award for the best article

An article by two FIT doctoral students, Karel Beneš and Murali Karthick Baskar, titled Residual Memory Networks in Language Modelling: Improving the Reputation of Feed-Forward Networks was awarded the Best Student Paper Award at the Interspeech 2017 conference in Stockholm.

Award for the best interactive presentation

Lukáš Sekanina, Zdeněk Vašíček, Radek Hrbáček, and Vojtěch Mrázek of the Evolvable Hardware research group were awarded a prize for the best interactive presentation at one of the biggest and most prestigious global events in the field of automatisation of computer systems design – the international conference Design, Automation and Test in Europe (DATE) held in Lausanne. Their contribution titled EvoApprox8b: Library of Approximate Adders and Multipliers for Circuit Design and Benchmarking of Approximation Methods introduced a new library of approximate adders and multipliers that can be used in low-power circuit architectures, e.g. for chip neural networks and the Internet of Things.

Award for the best poster

Štěpánka Bartošová and Martin Drahanský's poster for their article titled Fingerprint Damage Localizer and Detector of Skin Diseases from Fingerprint Image was awarded as the best poster at the BIOSIG conference in Darmstadt in Germany. The article describes a novel approach for detection and classification of skin diseases in fingerprints using three methods – Block Orientation Field, Histogram Analysis and Flood Fill.

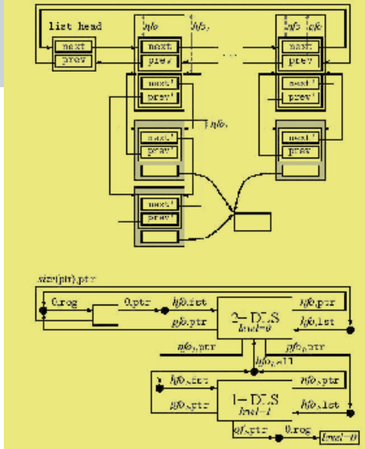
▶ **Evolvable Hardware research group was awarded a prize for the best interactive presentation at the international conference Design, Automation and Test in Europe held in Lausanne.**

Brno Ph.D. Talent

Kateřina Žmolíková's project titled Optimizing Multichannel Front-end for Far-field Speech Recognition was awarded in the Brno Ph.D. Talent contest. The project tries to improve the accuracy of speech recognition in unfavourable conditions, such as noisy environment or speakers talking over one another. The method uses signals from microphone arrays and their processing mostly by neural networks. Kateřina started her work on the project in her Master's thesis, and continued during her internship at NTT's Japanese research laboratory.

Predator

The Predator tool being developed at the Faculty of Information Technology by the VeriFIT research group won in the SV-COMP 2018 International Competition on Software Verification in MemSafety-Heap category. Predator was developed for automated verification of programs written in the C language which work with dynamic data structures based on pointers.



▲ The Predator tool won in the SV-COMP 2018 International Competition on Software Verification in the MemSafety-Heap category.

8 of BUT

FIT student David Kozák's work titled Accurate Heuristics for Noise Injection in the SearchBestie Tool dominated the 8 of BUT university-wide competition, in which the faculties select 8 best Bachelor's theses. In his presentation limited to 10 minutes, David Kozák managed to explain his work in a form comprehensible enough even for laymen without any background in IT.

◀ David Kozák managed to explain his work in a form comprehensible enough even for laymen without any background in IT.

The best Master's thesis in IT is from FIT

His Master's thesis won in the competition of 1700 theses from Czechia and Slovakia. In December, Jiří Matyáš became theabsolute winner of the IT SPY competition. Jiří and his research team found out how to save up to 90% of energy in mobile phones through a mere mathematical change in the circuit.

"The energy could also be saved in neural networks or signal processing, multimedia and "data mining", i.e. gathering knowledge from data," says Jiří Matyáš, a doctoral student at the Faculty of Information Technology. In 2017, Jiří was awarded the Award of the Rector of BUT for outstanding accomplishments in his Master's degree studies, and the results of his scientific work.

You verified your results on a supercomputer provided to you by theFaculty of Information Technology – how did it help you?

The method is based on evolutionary algorithms which look randomly for new solutions. That means that in practice, the results of two launches of a program with exactly the same initial settings can be completely different. To evaluate the performance of the relevant evolutionary method in a statistically reliable way, it is necessary to carry out a lot of experiments. The faculty's supercomputer helped us in doing so, as it is capable of running over a thousand parallel evolutionary runs. Thanks to this, we had the results in a few hours, whereas with regular computers, we would have to wait for weeks.

What are you working on at the moment?

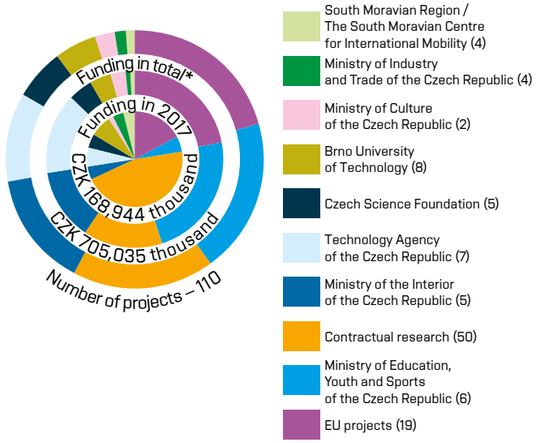
In my doctoral studies, I still work with and develop the idea of approximate calculations – we want our method to support more types of circuits and to be more user-friendly and faster.

Photo: IT SPY a Profinit EU

The Faculty of Information Technology ranks among the leaders in high-quality research in various areas in information technology – from hardware, through intelligent systems to multimedia. Over 20 research teams are participating in both national and international projects, whether on their own or in co-operation with other universities, research centres, or renowned companies.

Projects

The Faculty of Information Technology ranks among the leaders in high-quality research in various areas if IT. In 2017 the researchers at FIT collaborated with the industry and with partners abroad on more than grant projects with the total value exceeding 160 million Czech crowns. The largest projects have the scientists at FIT further researching supercomputing and embedded systems, developing new methods and tools for aggregated computer quality management of various systems, or researching advanced methods of obtaining and processing visual data, which will aid the security and rescue services in their work.



Name of the project	Research leader	Agency	Funding 2017 (CZK thousand)	Funding in total* (CZK thousand)
Advancing cryptanalytic methods through evolutionary computing	prof. Ing. Lukáš Sekanina, Ph.D.	CSF	732	2,210
Improving Robustness in Automatic Speaker Recognition	Ing. Ondřej Glembek, Ph.D.	CSF	1,844	5,532
ROBUST – veRificatiOn and Bug hUnting for advanced SofTware	prof. Ing. Tomáš Vojnar, Ph.D.	CSF	1,968	5,904
Relaxed equivalence checking for approximate computing	prof. Ing. Tomáš Vojnar, Ph.D.	CSF	2,716	8,148
Efficient Automata Techniques for Formal Reasoning	Mgr. Lukáš Holík, Ph.D.	CSF	3,166	9,498
Sequence summarizing neural networks for speaker recognition	Dr. Johan A. Rohdin	SMR/SMCIM	1,857	5,570
CPK — Using Semantic Technologies to Access Cultural Heritage Through The Central Portal of Czech Libraries	doc. RNDr. Pavel Smrž, Ph.D.	MC CR	3,910	19,093
Research and development of diagnostic unit for forming machines	doc. RNDr. Pavel Smrž, Ph.D.	MIT CR	368	2,094
Transfer of knowledge in the field of 3D reconstruction and 3D mapping	Ing. Michal Španěl, Ph.D.	MIT CR	637	1,593
Know-how transfer in the field of image processing in embedded devices	prof. Dr. Ing. Pavel Zemčík	MIT CR	1,264	2,211
Unconventional Design Techniques for Intrinsic Reconfiguration of Digital Circuits: From Materials to Implementation	doc. Ing. Richard Růžička, Ph.D., MBA	MEYS CR	175	1,898
CEPTIS — Computing Embedded Platforms for Traffic, Industry, and Surveillance	prof. Dr. Ing. Pavel Zemčík	MEYS CR	490	1,136
IT4Innovations excellence in science	prof. Ing. Tomáš Hruška, CSc.	MEYS CR	30,857	155,847
System for image data analysis to attend needs of Police of the Czech Republic	prof. Dr. Ing. Pavel Zemčík	MI CR	2,264	3,848
Information mining in speech acquired by distant microphones	doc. Dr. Ing. Jan Černocký	MI CR	2,333	11,688
Integrated platform for analysis of digital data from security incidents	Ing. Petr Matoušek, Ph.D., M.A.	MI CR	5,845	20,832
Smart Application Aware Embedded Probes	Ing. Jan Kořenek, Ph.D.	MI CR	6,747	25,311
Tools and methods for video and image processing to improve effectivity of rescue and security services operations	prof. Dr. Ing. Pavel Zemčík	MI CR	7,512	28,801
Reconfigurable ROS-based Resilient Reasoning Robotic Cooperating Systems	doc. RNDr. Pavel Smrž, Ph.D.	EU project	525	9,450
iARTIST – industry-Academia Research on Three-dimensional Image Sensing for Transportation	prof. Ing. Adam Herout, Ph.D.	EU project	971	971
Embedded multi-core systems for mixed criticality applications in dynamic and changeable real-time environments	prof. Dr. Ing. Pavel Zemčík	EU project	1,013	9,218
Social Semantic Emotion Analysis for Innovative Multilingual Big Data Analytics Markets	doc. RNDr. Pavel Smrž, Ph.D.	EU project	1,316	10,526
Algorithms, Design Methods, and Many-Core Execution Platform for Low-Power Massive Data-Rate Video and Image Processing	prof. Dr. Ing. Pavel Zemčík	EU project	1,599	13,463
MegaModelling at Runtime – scalable model-based framework for continuous development and runtime validation of complex systems	doc. RNDr. Pavel Smrž, Ph.D.	EU project	1,716	6,865
Robust SPEAKER Dlariazation systems using Bayesian inferenCE and deep learning methods	Mireia Diez Sánchez, M.Sc., Ph.D.	EU project	1,781	4,275
Photoacoustic/Ultrasound Mammoscopy for evaluating screening-detected lesions in the breast	doc. Ing. Jiří Jaroš, Ph.D.	EU project	3,284	12,474
Big speech data analytics for contact centres	doc. Dr. Ing. Jan Černocký	EU project	5,964	16,029
AQUAS: Aggregated Quality Assurance for Systems	prof. Ing. Tomáš Vojnar, Ph.D.	EU project	9,198	27,595
IotCloud – Intelligence for IoT systems	Ing. Jan Kořenek, Ph.D.	TA CR	879	2,637
Collaborative robot 2.0: cognition of the work environment, augmented reality-based user interface, simple deployment and reconfiguration	Ing. Zdeněk Materna	TA CR	923	5,688
Modern Image Processing Techniques and Computer-based Planning in Trauma Treatment	prof. Dr. Ing. Pavel Zemčík	TA CR	986	4,352
RODOS – Transport systems development centre	prof. Dr. Ing. Pavel Zemčík	TA CR	1,681	12,583
Meeting assistant (MINT)	doc. Dr. Ing. Jan Černocký	TA CR	2,796	9,088
IRONSTONE – IoT monitoring and forensics	Ing. Petr Matoušek, Ph.D., M.A.	TA CR	2,986	8,411
V3C – Visual Computing Competence Center	prof. Dr. Ing. Pavel Zemčík	TA CR	8,554	62,266

*Funding of the entire project throughout its development

TOP FIT PROJECTS

Project PAMMOTH Precision without radiation.

Researchers at FIT are developing a device which could replace the mammography device

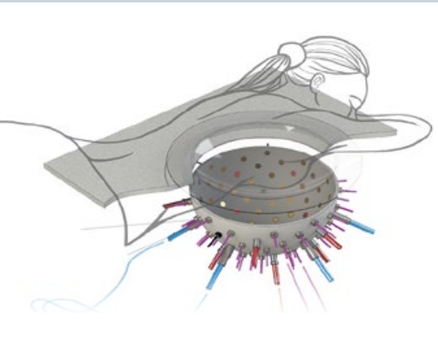
Supported by H2020

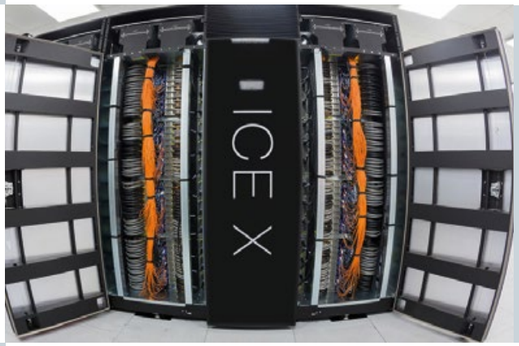
Precision without radiation. Such is the goal for the new breast imaging device which is now being developed by researchers at the Faculty of Information Technology at BUT together with other European scientists. In the future, the new 3D imaging technology could replace the current ultrasonic and x-ray based mammography devices.

Breast cancer is the most common kind of malignant growth in women — every year, it brings over one and a half million patients to oncological centres all over the world and about seven thousand patients in the Czech Republic alone. Today, breast cancer can be successfully treated - provided that the physicians are able to diagnose it correctly and in time. This is what project PAMMOTH aims to achieve. The researchers at FIT are working on the project in collaboration with eight other European research institutions. Together they are developing a device capable of non-invasive photoacoustic breast imaging allowing for a better and timely detection of tumours.

Unlike x-ray mammography and common ultrasound imaging, the system is able to identify the type of tissue and describe its oxygen and nutrient supply. This allows the system to find cysts, calcification and other pathological conditions which may develop into cancerous growth and which the current technology could either overlook or misdiagnose. The resolution of the 3D images obtained is also many times higher. This should make diagnostics significantly more precise and allow physicians to discover tumours much earlier.

Higher precision of the diagnostic method will also decrease the false positive rate, which is currently as high as 75%. This results in women undergoing further examination, including tissue sampling through biopsy. Unlike the mammography device, the system does not use radiation or contrast agents. Since these can be harmful, their use increases the requirements on the overall medical condition of the patient. The use of the imaging device causes no pain and significantly less discomfort to patients than ordinary mammography imagers.





Speed of data collection? Like internet connection for 100 households

Within the international project PAMMOTH the research team of Jiří Jaroš is responsible for collection, processing and evaluation of data from the photoacoustic imaging device. This bowl-shaped device with a diameter of 25 cm rotates around the patient's breast. Once every tenth of a second the device uses a battery of lasers to illuminate the breast tissue and record the resulting pressure wave using 512 ultrasonic sensors. The researchers at FIT then have to capture the data, perform a rough analysis and provide the clinical staff with a preview. All of that takes place at a data collection speed approaching 10 Gb per second, which would be enough to provide internet connection for 100 households.

The data collected by the research team in Brno is then further processed in the IT4Innovations supercomputer centre in Ostrava. In the centre, hundreds of supercomputers work on reconstructing the image of the tissue into a three dimensional image. The team from the Faculty of Information Technology must then be able to deliver the resulting image within 48 hours of the imaging.

"When the reconstruction is complete, the physician receives a three dimensional image of the breast highlighting individual types of tissue, vascularity, blood oxygenation, calcification and cysts. The physician is free to move around inside the model, rotate it and zoom in up to the resolution of 0.5 mm per picture element," said Jiří Jaroš.

Unique combination of two technologies

Project PAMMOTH combines two non-invasive imaging methods — ultrasound and photoacoustic imaging. This allows the system to evaluate various properties of the tissue, e.g. its density, rigidity or oxygenation. Ultrasound mammography provides information on the anatomy of the breast and creates a map of the tissue. Photoacoustic mammography then uses laser, which is absorbed in blood vessels with higher concentration of oxygenated blood; this allows it to identify tissues with high blood flow which indicate cancerous growth.

The researchers are currently working on a prototype of the device and testing the technology on various simulations and artificial breast samples. A pilot study with human patients should commence in 2019 — the researchers at FIT will be processing data from patients in Twente, Netherlands. In the future, the method may also be used to diagnose cancer in the abdominal cavity, e.g. the liver, kidneys or pancreas.

Over EUR 5 million

Project PAMMOTH is worth more than 5 million euro, which is over 127 million Czech crowns, and falls under the European Union Horizon 2020 programme. 6 researchers from the Faculty of Information Technology are currently working on the project. Apart from BUT, the project employs 70 more workers from 3 universities — a university in London (UCL), Bern (UB) and Twente (UT), and 5 industry partners - Imasonic (ultrasonic detectors), EXPLA (laser), PA Imaging (assembling the device), Medisch Spectrum Twente (clinical trials) and TP21 (management).

Principal research worker: **Jiří Jaroš**
Commencement of the project: **1 January 2017**
Completion of the project: **31 December 2020**
Total funds: **EUR 385,000**

Project AQUAS: How to develop systems without risk and more efficiently?

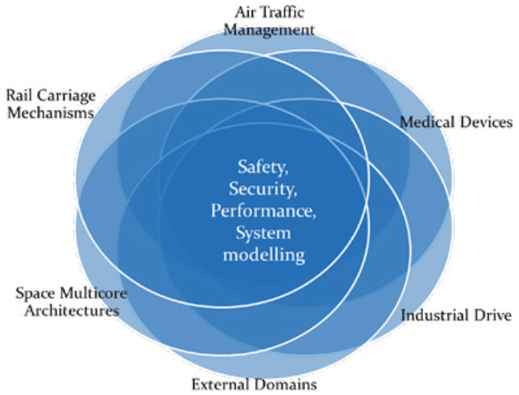
Supported by H2020 ECSEL and the Ministry of Education, Youth and Sports of the Czech Republic

Computer-managed systems are becoming progressively more complex. How to ensure they are safe and reliable while being effective? The researchers at FIT are developing new methods and tools for aggregated quality assurance in co-operation with 22 other partner institutions from seven countries of the European Union.

Their common goal is to develop a coordinated engineering process which should lead to an improvement in competitiveness of key areas of European industry.

At this stage, the methods and tools being developed within the project are undergoing testing on case studies from the areas of aerospace, space, automotive, rail and medical devices.

Principal research worker: **Tomáš Vojnar**
Commencement of the project :**1 May 2017**
Completion of the project: **30 April 2020**
Total funds: **EUR 851,685**



Project Collaborative robot 2.0 Hand in hand with a robot

Supported by the ZÉTA programme of the Technology Agency of the Czech Republic

Robots working hand in hand with people — safely, efficiently and without the need for an expert intervention. This is the aim of the project Collaborative robot 2.0: cognition of the work environment, augmented reality-based user interface, simple deployment and reconfiguration. At the Faculty of Information Technology the project is mainly realized by doctoral students.

The research is focused mainly on effectiveness and safety of this close collaboration, its goal is to enable deployment of robots in small and medium-sized businesses. The currently available solutions are often unsuitable for smaller enterprises, since the commissioning and any adaptation requires the presence of an expert, and because of the lack of a user interface and the inability to perceive human co-workers as well as the work environment and its current state.

The project aims to involve young researchers and utilise the know-how of the application partner in the development of software which would address these deficiencies. The software will be available as open-source, which will allow integrators to use it as basis to create a solution for specific industry applications.

Principal research worker: **Zdeněk Materna**
Commencement of the project: **1 September 2017**
Completion of the project: **31 August 2019**
Total funds: **CZK 5 994 761,00**

Project VRASSEO

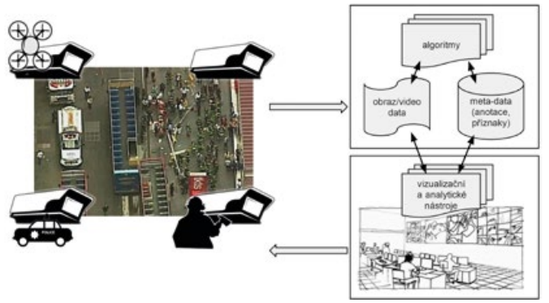
Tools and methods for video and image processing to improve effectivity of rescue and security services operations

Supported by the Ministry of the Interior of the Czech Republic

Creating a functional sample of a system which would help improve effectivity of rescue and security services operations. These are the main objectives of the project VRASSEO.

Within the framework of the project, the researchers at FIT concentrate on developing methods of obtaining and processing images and video sequences. The system will facilitate the extraction and analysis of the information gathered from various sources of images from the site of an incident, its categorisation, search, aggregation, archiving and effective representation.

Principal research worker: **Pavel Zemčík**
Commencement of the project: **1 January 2017**
Completion of the project: **31 December 2020**
Total funds: **CZK 23 165 000,00**



Project MOST

Modern and open studies in technology

Supported by OP Research, Development and Education

The objective of the project is to improve the quality and relevance of education at BUT in relation to the actual needs of the graduates, employers and businesses. The project includes interventions in all areas of education at BUT (with the exception of PhD studies). The project concerns a set of strategic activities which react to changes in the outside environment (growth of the knowledge economy and the changing conditions of the labour market) and any identified internal deficiencies. Implementation of interconnected activities by the faculties and component parts will lead to increase in quality, both in the field and overall, increase in relevance and openness of education at the BUT. The knowledge and skills of the graduates at the end of the education process will better correspond to the needs of the employers and the knowledge economics.

Principal research worker at FIT: **Richard Růžička**
Commencement of the project: **1 September 2017**
Completion of the project: **31 December 2022**
Total funds: **CZK 155 511 304,94**

EUROPEAN UNION
European Structural and Investment Funds
Operational Programme Research, Development and Education

MINISTRY OF EDUCATION, YOUTH AND SPORTS

IMSIT

Infrastructure for modern studies in IT

Supported by OP Research, Development and Education

Modernisation of the classrooms and instrumentation for teaching of technology-focused courses, as well as modernisation of the support multimedia systems in the lecture halls allowing for transmission and recording (and the subsequent inclusion of the output into the multimedia study resources) which will improve teaching of more theoretically-oriented courses. This modernisation reflects the needs of the labour market where the knowledge of current technologies and the ability to continue to learn allows recent graduates to find employment.

Principal research worker: **Richard Růžička**
Commencement of the project: **10 ctober 2017**
Completion of the project: **30 September 2022**
Total funds: **CZK 13 503 498,55**

EUROPEAN UNION
European Structural and Investment Funds
Operational Programme Research,
Development and Education

MINISTRY OF EDUCATION, YOUTH AND SPORTS

Project ROBUST

Verification and bug hunting for advanced software

Supported by the Grant Agency of the Czech Republic

These methods can save both funds and human lives. Both the academia and industry have an active interest in automated verification and software debugging. Researchers at FIT are developing automated methods of static formal verification.

This project aims to develop new automated methods of static formal verification based on approaches like symbolic verification or automated abstraction, as well as extrapolating dynamic analysis and advanced testing of programs that use several classes of advanced programming constructions.

The project concentrates on pointer programs, concurrent programs (including cloud programs), and container programs. While these areas are to some degree independent, there is also a lot of overlap among them: On one hand, one needs to consider various combinations of the mentioned constructions (e.g., concurrent pointer programs). On the other hand, one needs to solve similar problems for all of them. An important example of the latter considered in the project is dealing with open programs, i.e., program fragments that the programmers need to verify despite their environment being unknown.

Principal research worker: **Tomáš Vojnar**
Commencement of the project: **1 January 2017**
Completion of the project: **31 December 2019**
Total funds: **CZK 8 958 000,00**

ACHIEVEMENTS OF RESEARCH GROUPS

Research and development

SC@FIT

In 2017, the Supercomputing Technologies Research Group achieved some noteworthy results in acceleration of ultrasound simulations. The simultaneous use of 512 GPUs of the third most powerful supercomputer in the world, the Piz Daint, made it possible to create a realistic simulation of the propagation of ultrasound in a simulation domain of 69 billion grid points with a calculation time of 0.3 s for each step. The entire simulation could therefore be completed in less than 10 hours. This resolution allows for a precise model of an ultrasound operation in more than 1 litre of tissue, or to perform photoacoustic imaging of up to 16 litres of volume.

CPHOTO@FIT

The Computational Photography Group has created and published a new dataset, GeoPose3K, which comprises over three thousand photos together with their precise location and camera orientation. Each photo is also accompanied by an absolute depth map calibrated in metres, surface normals, synthetic semantic segmentation and approximation of daytime illumination. The GeoPose3K was published abroad in the prestigious scientific journal IMAVIS.

Project, grant

SPEECH@FIT

Google is not only the largest IT company, it is also a sponsor of academic research. In 2017, Oldřich Plchot from the DCGM received 60 thousand dollars from the Faculty research Award programme for the project End-to-end DNN Speaker recognition system to support the research of speaker recognition with the help of neural networks. It was one of four grants awarded in the area of speech processing
which puts FIT in good company of Carnegie Mellon University and University of Cambridge. The grant Oldřich Plocht received is one of two such grants awarded to researchers in the Czech Republic.

KNOT@FIT

The Knowledge Technology Research Group KNOT@FIT was granted the European project Cross-CPP — Ecosystem for Services based on integrated Cross-sectorial Data Streams from multiple Cyber Physical Products and Open Data Sources. We collaborate on the project led by the ATB institute in Bremen with such titans of industry as Volkswagen, Siemens and other companies, with the aim to create an environment for sharing of data streams and analysis across sectors of technology. The project will, for example, enable the integration of information from passenger cars and intelligent buildings, and thus allow for the creation of services which will bring about a new level of quality and convenience to the use of goods with cyber-physical qualities. In the project we also emphasise maintaining the confidentiality of commercial data, protection of privacy and intellectual property rights, and ethical issues, using the context approach.

INTSYS@FIT

In 2017, the members of the Intelligent Systems Research Group established mutual co-operation with the Department of Auxiliary Historical Sciences and Archive Studies and together they were awarded a grant from TACR for the project "Possibilities for creation of communite genealogical database with semantic information and uncertainty". This project follows up on the last year results of the members of the research group in the area of computed processing of historical documents, which were published in conference proceedings.

Product

MSWI@FIT

The Management of software engineering Research Group created a tool for formalization of the business rules using business vocabulary and semantics. Software for formalisation of business rules uses the "business rules layer" which separates the code of the rules from the code of the application.

Awards

EHW@FIT

Lukáš Sekanina, head of the Evolvable Hardware research group, received the President Prize for outstanding results achieved in the project Advanced Methods for Evolutionary Design of Complex Digital Circuits.

Publications

DIAG@FIT

Journal article: PODIVÍNSKÝ Jakub, ČEKAN Ondřej, LOJDA Jakub, ZACHARIÁŠOVÁ Marcela, KRČMA Martin and KOTÁSEK Zdeněk. Functional Verification Based Platform for Evaluating Fault Tolerance Properties. Microprocessors and Microsystems. Amsterdam: Elsevier Science, 2017, vol. 52, No. 5, pp. 145-159. Available at: QR code

FM@FIT

A monography published by the international scientific publishing house Springer:
MEDUNA Alexander and SOUKUP Ondřej. Modern Language Models and Computation: Theory with Applications. New York: Springer US, 2017.

IS@FIT

Journal article: ZELENÝ Jan, BURGET Radek and ZENDULKA Jaroslav. Box Clustering Segmentation: A New Method for Vision-based Page Preprocessing. Information Processing and Management. 2017, Vol. 53, No. 3, pp. 735-750. Available at: QR code

Co-operation

HPC@FIT

The High Performance Computing Research Group engaged in successful cooperation with TU Vienna in project AKTION, "Exploring new Applications for Modern Taylor Series Methods to Solve Stiff and High-Order Systems". The project included a number of professional lectures by academic staff and students, challenging application problems were studied, and a number of young researchers was given the opportunity to gather international and interdisciplinary experience.

Research groups at FIT

ANT@FIT	Accelerated Network Technologies Research Group
BUSLAB@FIT	Brno University Security Laboratory
CPHOTO@FIT	Computational Photography Group
DIAG@FIT	Dependable Systems Research Group
EHW@FIT	Evolvable Hardware Research Group
FM@FIT	Formal Model Research Group
GRAPH@FIT	Computer Graphics Research Group
HPC@FIT	High Performance Computing Research Group
INTSYS@FIT	Intelligent Systems Research Group
IS@FIT	Information and Database Systems Research Group
KNOT@FIT	Knowledge Technology Research Group
LISSOM@FIT	Hardware-Software Codesign Research Group
MODSIM@FIT	System Modelling and Optimization Research Group
MSWI@FIT	Management of software engineering Research Group
NES@FIT	Networked and embedded systems research group
POLY@FIT	Unconventional Digital Circuits Research Group
ROBO@FIT	Robotic research group Robo@FIT
SC@FIT	Supercomputing Technologies Research Group
SPEECH@FIT	Speech Data Mining Research Group
STRADE@FIT	Security Technology Research and Development
VERIFIT@FIT	Automated Analysis and Verification Research Group

FIT institutes and centres

Department of Information Systems

The Department of Information Systems is responsible for teaching the Masters specialisation Information Systems, which covers such fields as programming, formal languages and compilers, database and information systems, computer networks, formal specifications, internet and distributed applications. Scientific and research activities of the Department includes database technology, implementation of information systems, management of software projects, theory of formal languages and compilers.

Department of Intelligent Systems

The Department of Intelligent Systems is responsible for teaching the courses comprising three Master's specialisations which are the Information Technology Security, Intelligent Systems and Mathematical Methods in Information Technology. The research activity of the Department is focused first of all on Intelligent Systems, especially the biometric systems and robotics, but attention is also paid to systems for specific applications, communication systems and sensor networks.

Department of Computer Graphics and Multimedia

Department of Computer Graphics and Multimedia deals with research and education in human-computer interaction, multimedia and multimodal data mining, image and video processing, computer graphics, speech data mining, advanced approaches to automatic control, knowledge technologies and big data processing. DCGM has specialized equipment for human-computer interaction: two aircraft simulators for the development of R&D in user interfaces and autonomous automatic systems in aviation, a PR2 robot, 3D video-projection equipment, holography lab, terabyte corpora of images, speech, and text and a multichannel audio acquisition equipment.

Department of Computer Systems

The Department of Computer Systems is mainly responsible for teaching hardware-oriented courses in Bachelor's, Master's and Doctoral study programmes. In the follow-up Master's study programme, two branches of study are guaranteed by UPSY: Computer and Embedded Systems, and Bioinformatics and Biocomputing. Scientific and research activities of the Department are focused on HW/SW architecture of computer systems at the levels of digital circuits, single- and multiple-core processors (including GPUs), embedded systems, application-specific integrated circuits, reconfigurable systems based on FPGAs, computer clusters and supercomputers.

Research Centre of Information Technology – IT4Innovations

The IT4I research centre is a unique project combining the function of a research centre for academic purposes, with research for the purposes of the industry and co-operation with business subjects by the means of contractual co-operation. The main areas of research are the identification and presentation of information from multimedia data, and safe and reliable architectures, networks and protocols. The centre offers some excellent opportunities for the students — they can acquaint themselves with top projects, and also with how the work is done outside the academia. The centre also includes the access to the Salomon supercomputer.

Computer Centre

The Computer Centre provides for the operation of computer laboratories, computer technology, the faculty computer network, servers and information systems. Computer laboratories located in the centre are used both for scheduled teaching and for working on projects, theses and research tasks. Outside scheduled teaching, the laboratories are freely available to all students of the Faculty of Information Technology.

31 SW products

- AppIdent — Tool for Network Application Protocols Identification
- Bilateral filter for HDR tone mapping (IP core)
- C++ implementation of the k-Wave Toolbox version 1.2
- CUDA implementation of the k-Wave Toolbox version 1.1
- DDoS Generator
- LwM2M Demonstration (Smart Metering)
- Dermatoglyphix 1.0
- Formalization of the business rules — Extension
- FOS: Fast ODE Solver
- Gaston - Symbolic WS1S Solver
- HIP 1.1 - High-sensitive Innominate Processing
- Hardware object detector in video stream
- Library of SDM software modules and firmware for network traffic filtering at the layer of application protocols, using an FPGA SoC
- Cryptocurrency Analyzer
- Modul pro zpracování zapouzdřeného síťového provozu (Module for processing of encapsulated network communication)
- Tool for detection of mobile device in network communication
- Tool for data extraction from Android devices
- A tool for formalization of the business rules using business vocabulary and semantics
- Nástroj pro zachycení síťové komunikace spolu s identifikací aplikací na platformách Windows, Linux, (BSD) (A tool for network traffic capture and application identification on the Windows, Linux, (BSD) platforms)
- Non-Separable Schemes for Discrete Wavelet Transform for Multi-Core CPUs
- Non-Separable Schemes for Discrete Wavelet Transform in Pixel Shaders
- Netfox Detective 2.0 — Tool for Network Forensic Analysis
- RDF4J Class Builder
- RINASim — DAF Extension
- Software for Predicting Vehicle Occurrence in Given Interval and Road Section
- HDR merging and deghosting software
- Collaborative robot 2.0: calibration
- System for Automatic Semantic Enrichment of Bibliographic Data
- Timeline Analyzer
- uFFT
- Collaborative robot augmented reality-based user interface

2 functional samples

- Shooting equipment for short firearms
- Lawful Interception L7 Probe

student project with an industry partner

Retargetable Decompiler RetDec, the LLVM-based retargetable binary decompiler developed in co-operation between the students of FIT and the company Avast, has been released as open-source. The decompiler has been in development since 2011, students at FIT continue to contribute to its development under the scholarship programme of Avast within their bachelor's, master's and doctoral theses.

The source codes are available at GitHub:

You can try RetDec through the web service:

1 patent

A multispectral lifecycle detector especially suited for the fingerprint recognition technologyRegistration 2017, acceptance 2018, expiration 2021

Authors: Drahanský Martin, Dvořák Radim, Váňa Jan, Goldmann Tomáš, Dvořák Michal, Kanich Ondřej

Type: utility design

Owner: Touchless Biometric Systems s.r.o.

240 publications

124 articles in conference proceedings
47 articles in scientific journals
52 technical reports
5 chapters in books
9 presentations
2 manuals
1 monography

9 conferences (co-)hosted by the school

with over 60 participants **5**
international conferences **4**

Newly appointed Professors and Assistant Professors

V červnu prezident ČR Miloš Zeman podepsal jmenovací dekrety 86 nových profesorů vysokých škol. Ve Velké aule pražského Karolina pak převzalo jmenovací dekret z rukou ministra školství, mládeže a tělovýchovy Stanislava Štecha 86 nových profesorek a profesorů – mezi nimi také Martin Drahanský.

prof. Ing., Dipl.-Ing. Martin DRAHANSKÝ, Ph.D.

in the field of: Computer Science and Engineering on a proposal from the Scientific Board of Brno University of Technology

Expertise:
- Biometric systems
- Image and video processing
- Security and cryptography
- Sensor systems

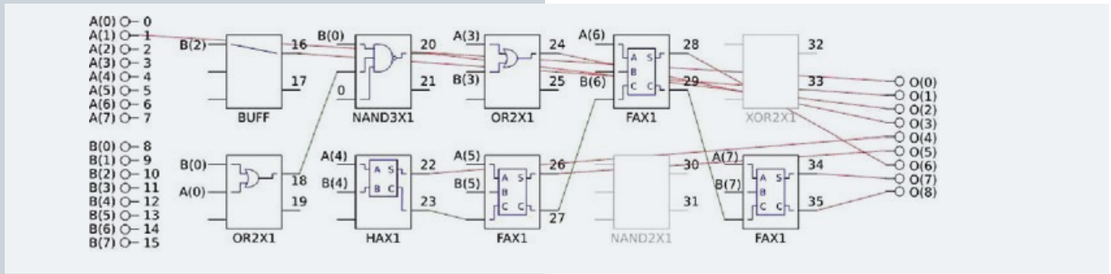
Assistant Professors appointed by the Rector of BUT in 2017

doc. Ing. Zdeněk Vašíček, Ph.D.

název habilitační práce:
New Methods for Synthesis and Approximation of Logic Circuits

doc. Ing. Jiří Jaroš, Ph.D.

název habilitační práce:
High Performance Computing in Ultrasound Cancer Treatment



People in the spotlight

FIT researchers used artificial intelligence to save energy in computers

Artificial intelligence is not omnipotent, of course, but it can make a lot of people's work easier and save their time. The research team at the Faculty of Information Technology that used evolutionary algorithms to automate the design of computer component knows this. The algorithms can be used in battery-powered devices where optimisation of ongoing operations is needed to reduce energy consumption.

Vojtěch Mrázek, Radek Hrbáček, Zdeněk Vašíček, and Lukáš Sekanina from the Evolvable Hardware research group have long been focusing on the application of evolutionary algorithms. They are currently focusing on their application in automated design of computer circuits. What does that mean? "For example, let's have a look at an adder. We wanted for it to have as low power input as possible, even if it meant an occasional mistake in the addition. Such occasional mistake is not really a problem for example in processing pictures where various values of pixels are added. A slight inaccuracy is hardly noticeable with the naked eye," said Lukáš Sekanina. Therefore, the experts tried to come up with a solution that would be the best compromise between error rate and power input. Not only have they managed that, but using artificial intelligence, they found an enormous amount of similar compromise solutions and created a library of approximate computer components.

"Based on requirements, e.g. required power consumption, our software can choose the most advantageous implementation from the point of view of error rate or performance from the library. It is possible to come up with five to ten options manually, but using the AI, we managed to come up with 430," Sekanina added. He also noted that the library is freely accessible at the project's website.

What are the practical applications of this software? The software can be put to use mostly in battery-powered devices where the battery endurance is emphasised, and the accuracy of calculations is less important. Playing videos on a mobile phone can serve as an example. If the battery is running low, the device will prioritise saving the battery over the video quality. Another way to use the algorithm is for smart glasses with intelligent object recognition. That requires image processing that is demanding both in terms of computing power and in energy consumption. Without the circuit solution with low power input, the operations would not be possible with the small battery in smart glasses.

The solution was successful at a prestigious conference

The foursome of experts presented the software at the spring DATE conference in Lausanne in Switzerland, one of the biggest and most prestigious global events in the field of automated of computer systems design, such as circuits, processors etc. Interestingly enough, the conference is primarily focused on traditional software used to design hardware, and yet the evaluation committee found the contribution of the four Brno researchers focusing on artificial intelligence the most interesting one. "We were different from the others – we used artificial intelligence and made it come up with a design of adders and multipliers with low power input."It is also not very common for all the professional reviewers of the submitted papers to award similar scores. "However, that was the case for us, and we got great evaluation from everyone," said Sekanina. Moreover, their contribution found success among the competition of 794 papers submitted from all over the world. The committee then chose ninety contributions in the category of interactive presentations, the BUT team's among them. It then became assessed as the best one in the category.

Researchers at FIT are able to make low quality photos and text more focused. They needed hundreds of thousands pictures to achieve that.

Taking a picture of quite a low quality where the details cannot be made out occasionally happens to everybody. Various computer programs can fix a lot. However, where classic software reaches its limits, one needs more complex operations. That is why the experts at the Faculty of Information Technology work with photography editing using convolutional neural networks. That may allow for making various historical documents at the Moravian Library in Brno become more focused and readable.

Nowadays, convolutional neural networks are mostly used in the field of artificial intelligence. Michal Hradiš and his team decided to use them in their research of automated photography focusing and other corrections of picture imperfections. For two years, they taught the networks to recognise which photos are of good quality and how to process the imperfect ones to be as close to reality as possible.

"We used several hundred thousand pairs of pictures, where one was of good quality, and the second one was artificially blurred. The convolutional networks are able to use these examples to learn to change the pictures so that they are as close to the original as possible. If we present them enough training examples, in time, the networks will be able to fix real photographs that they have not seen yet," explained Michal Hradiš of the Department of Computer Graphics and Multimedia.

This method is very successful, for example, when photographing text documents with a mobile phone, where even unreadable photos nearly rival the quality of desktop scanners after processing. Not only are the focused documents more readable, they also work much better with OCR, i.e. the automatic text recognition.

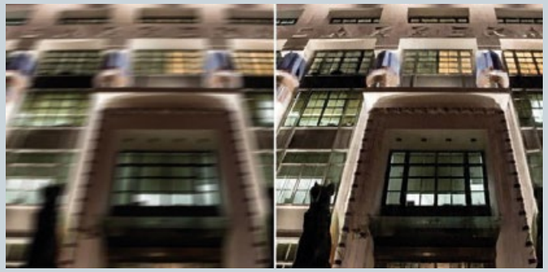
The researchers also focused on videos, in particular those from traffic cameras. They experimented with licence plate numbers in pictures from motorway cameras and toll gates. The program is able to determine the licence plate number even from a recording that is not very focused. So far, the method is not being used in this area, but could be applied in the future, for example in security.

At the moment, the scientists are improving the method for texts. "We are preparing a project where we will try to reconstruct old prints and manuscripts. The Moravian Library has a digital archive, making some old documents, such as old newspaper, available to the public. Some of the scans are readable, but with a lot of difficulties. These are the ones we are now using in experiments with the convolutional neural networks," Hradiš said, explaining their plans for the future.

The limitation is that a damaged document must retain at least some information on the original contents. For example, it is possible to fill in small torn out parts and the result will look plausible, but the text will not make any sense. Similarly, the letters and font might be changed if the text is too blurred.

Thanks to the convolutional neural networks, it is now possible to edit texts as well.

Researchers at the Faculty of Information Technology have been interested in convolutional neural networks for years and keep looking for their new applications in practice. They started with recognition and search of the contents of photographs, but this area is now being explored by research teams of big companies such as Google and Facebook. That is why at FIT, the researchers focus on the areas where further use of the networks is yet to be found.



Author: Michal Hradiš

They can recognize who is speaking in recordings. The researchers' application is in demand by secret services as well as by loan companies.

More than 20 years ago, a group called BUT Speech@FIT was established at the university and is now participating in projects focused on speech recognition for the American government, as well as other entities. The founder of the group, Jan Černocký from the Faculty of Information Technology, is still the head of the group. He admits that the beginnings were quite tough, and they had to work really hard to become successful in the field. Even now, when they work on prestigious global projects, they cannot afford to slow down. Americans, for example, continuously evaluate each team, and the weakest links are simply let go.

Jan Černocký started his research career at the Faculty of Electrical Engineering and Computer Science of BUT. Still a doctoral student, he managed to get a job at then newly established laboratory for signal processing led by Professor Šebesta, and there he focused mostly on speech processing. "At that time, we were really only getting started, and looking back, it was more a play than a serious research," said Černocký. Thanks to his studies in Paris, however, he managed to co-operate with his French colleagues after completing his doctorate, who subsequently invited the Czech team to the first European Speechdat East project. After the Faculty of Information Technology was established, he and the emerging group joined the newly formed Department of Computer Graphics and Multimedia.

According to Černocký, the second turning point was meeting Hynek Heřmanský, who is recognised as one of the world's superstars of speech processing and who worked at American universities for many years. Thanks to Heřmanský, the young Czech researchers got on internships in the USA and have gone through several major projects. "At the beginning, we often had no clue what was going on. However, we kept going places and learned, so we gradually improved," Černocký added.

In 2005, they used this experience in the international evaluation of language recognition systems where they, as a new group, surprisingly achieved the best results. "Suddenly everybody was interested in where Brno is and what BUT is," remembers Černocký. A year later, they repeated their success in speaker recognition, which confirmed their place among the elite international circle in the field. "That helped us to get involved in projects financed by the American government. Those projects are very tough because they are continuously evaluated and the teams with the weakest results are simply eliminated," said Černocký, adding that his team had never not finished a project. Last year, Speech@FIT also won the prize of the Technology Agency of the Czech Republic for the usefulness of its solutions, and a member of the team, Kateřina Žmolíková, received the Brno PhD Talent award for her research.

In addition, over a decade ago, the researchers founded Phonexia, a company where they can use the findings of their research in practice. "We needed the company when we started co-operating with the Czech Ministry of Defence. Our colleagues from the army liked discussing our research with us, but wanted production technologies which we were not able to provide them with at BUT," explained Černocký.

According to Černocký, the products that they now supply are able to literally mine information from speech. "To put it simply, we receive a recording that was not made for computer recognition. Then we try to get as much information as possible from it. When two people are talking, we try to determine who talked when. When there was silence and when people were talking. That sounds like an easy task, but when we receive recordings from a walkie-talkie where there is a lot of static and crackling, it is not that simple," said Černocký.

The researches can also dig up the contents of the speech. "That means we have to transcribe the exchange. The only difference is that the data we receive are significantly worse than those from the media. There are many unfinished sentences, swearing, speech disorders and dialects. We have to deal with all of that," Černocký added.

Thanks to the speech technology, secret services are able to go through a large amount of speech much faster and find what they need. Banks and loan companies can find out whether anyone is trying to get a loan under several false identities. According to Černocký, not even changing the voice is enough to fool modern systems.

Anonymising software can edit videos on its own. It is useful for both the police and the media.

The software allowing to automatically anonymise video recordings was developed by the experts at the Faculty of Information Technology. It is enough to simply mark an object in the video that is not to be recognisable, and the program will find and blur it on its own. According to Filip Orság, one of the creators of the software, the application will be most useful for the police and the media.

Until now, police officers had to blur the faces of witnesses and licence plate numbers manually. The software developed at the Faculty of Information Technology might make their work easier. "Imagine that you are a policeman and there is a video from the crime scene. The press approaches you and asks for the video for television. That is not possible as in many cases, it is not possible according to the law to make people's faces and licence plate numbers public. The practice so far has been that the police officer has to sit down and manually mark all the places where the object appears in the video. With our software, it is enough to mark the object I want to hide just once and then the algorithm searches for it in the rest of the video and hides it," said Filip Orság, who led the development of anonymisation software.

The software development and algorithm research was carried out within a project that the faculty received from the Ministry of the Interior. "The whole project titled Nástroje a metody zpracování videa a obrazu pro boj s terorismem (Video and Image Processing Tools and Methods for Combating Terrorism) was focused on video and image processing for the purpose of researching algorithms for categorising, searching and comparing biometric data and other processing of image and video information. For example, the ability to detect that a person caught on a surveillance camera carries a weapon. The software was just one of many outcomes of the projects," said Orság.

The final software was presented by experts from the faculty to representatives of the Police of the Czech Republic. "They' received a demo version from us to try working with the program. At the moment, the application is in the testing phase and we are waiting whether there will be an interest in it," said Orság.

The software is not yet complete and its authors are not planning to offer it as a regular commercial product yet. "We do not want to spend time on this and fix all the details if we do not see the interest of potential users," said Filip Orság, adding that the sale of the application, user support, and training is a far more fitting job for a company than a university.

Top technology

One of the most powerful computers in the world, a unique simulator, or a computing cluster. The Faculty of Information Technology provides its teachers and students with state-of-the-art technologies.

Laboratories:

Security and Industry 4.0
laboratory dedicated to research in this field

Network Lab
analysis, monitoring and security of high-speed computer networks

Printed Circuits Laboratory
design, manufacture, installation and recovery of printed circuit boards for electronic devices at the level of current trends

Biometric Laboratory
fingerprints, dactyloscopy, liveness detection, hand, font and signature recognition, hand veins recognition, iris, retina, and face recognition

Multimedia Laboratory for Design of Advanced Integrated Systems
operator support systems for demanding activities

Robotic Lab
ground and air platforms, measurements, fusion and reconstruction of 3D data, planning of operations and missions, development of specific platforms and electronics

Laboratory for Human-Machine Communication
integration of sensory and visualization devices (VR / AR) for close co-operation of people with robots

Laboratory of Microscopic Analysis
microscopic analysis of chips and wireless communication

Optical Laboratory
Holography and HDR imaging

Data and Computing Centre
computing cluster (SGE) and data centre

LIVELY FACULTY

Events

Life at the Faculty of Information Technology is not only about studies and research, but also conferences, lectures delivered by interesting speakers, and a festival of our students' bands. Various events held throughout the whole year bring life to the Faculty of Information Technology.

1 2 3 4 5 6 7 8 9 10 11 12

3 January
TOMÁŠ MIKOLOV'S LECTURE

Tomáš Mikolov returned to his alma mater after several years to deliver his lecture: "Neural Networks for Natural Language Processing". Immediately after he defended his dissertation at FIT in 2012, he was admitted to the Google Brain team, and after two years moved on to a research group working with artificial intelligence at Facebook (FAIR). His article titled Distributed representations of words and phrases and their compositionality" has been referenced 2855 times on Google Scholar, and his software, word2vec, is used by the largest global search engines to process natural language.

13 January
OPEN DOORS DAY FOR PROSPECTIVE STUDENTS

20 January
REPRESENTATIVE BALL OF FEEC AND FIT ▲

1 2 3 4 5 6 7 8 9 10 11 12

1 to 4 February
HIVISCOMP ▼

A traditional meeting of professionals in the fields of computer vision, graphics, and photography, HiVisComp 2017, organised by the Faculty of Information Technology took place at the beginning of February in Beskydy. The event was attended by more than 80 researches, companies' representatives, and artists.

27 to 29 February
DEVCONF

The ninth DevConf conference which is the biggest event for developers, administrators, and users of Linux and open source in Central Europe traditionally tok place at the Faculty of Information Technology. The faculty welcomed almost 1500 attendees and over 200 speakers from all over the world, talking mainly about the current issues of the OpenSource world.

1 2 3 4 5 6 7 8 9 10 11 12

3 March
FIT STUDENTS' BALL ▶

1 2 3 4 5 6 7 8 9 10 11 12

25 April
ROCK@FIT AND THE CLOSED DOORS DAY ▼

A mini festival for the faculty's student bands, and the Closed Doors Day offering activities such as disorienteering, debugging of the faculty, and a quiz.

26 April
LET'S DO SCIENCE AT FIT

The Open Doors Day for the applicant to the doctoral studies with presentations of research groups and meeting the students and researches at the faculty.

27 April
GIRLS DAY

Girls Day is an interactive version of the Open Doors Day aimed at women who were offered a unique opportunity to get to know the wide range of study programmes and job opportunities in fields such as IT. The attendees could try a flight simulator, play an interactive simulation and strategy game, and visit the historic underground of the campus.

CO-OPERATION WITH INDIA

The Faculty of Information Technology concluded a framework contract with International Institute of Information Technology, Hyderabad (IIIT-H). With over a billion inhabitants, India is becoming an IT superpower and there are several excellent students and employees from India at FIT and several partner companies. The contract with IIIT-H will allow for further co-operation with the excellent institution.

1 2 3 4 **5** 6 7 8 9 10 11 12

3 May
EXCEL@FIT STUDENT CONFERENCE ▲

Excel@FIT is a student conference focused on innovations, technology and science in the area of IT, and tens of interesting results and examples of the students' creative work presented in an untraditional form.

Over 60 student papers were presented at the conference this year. The expert jury then chose 25 best papers, whose authors were granted a scholarship in the amount of CZK 7,000. TOP 5 was also elected by the public.

VISIT OF FIT TEACHERS TO KENYA?

As part of the international co-operation between FIT and Strathmore University in Nairobi, teachers from the faculty spent a week at the Kenyan university. While there, the teachers prepared practical exercises and seminars for the local students, focusing on the area of network forensic analysis and security. The visit was an extension of long-term co-operation of the universities focused on the studies of Kenyan students in the Information Systems Security Master's study programme.

1 2 3 4 5 **6** 7 8 9 10 11 12

3 June
BARCAMP ▶

As is the tradition, the eighth BarCamp Brno took place at the Faculty of Information Technology. This year, the event was attended by almost 1500 visitors. BarCamp is an international network of user-generated open conferences. BarCamp Brno is the biggest event of its kind in the Czech Republic.

27 June
GRADUATION ▼

Every year at the end of June, the fountain in the FIT courtyard is filled with rubber ducks. Rubber ducks became a symbol of people in IT, so the fresh graduates let them out in the fountain after their graduation.

1 2 3 4 5 6 **7** 8 9 10 11 12

SUMMER OF HPC

Another student of the Faculty of Information Technology managed to be selected for the Summer of HPC training programme. Petr Stehlík will participate in a two-month study programme at the CINECA supercomputer centre in Bologna.

1 2 3 4 5 6 7 **8** 9 10 11 12

SUMMER SCHOOL FOR KENYAN STUDENTS ▲

Summer school for Kenyan students took place at the FIT at the end of August. This was the second summer school organised in co-operation with University Strathmore in Nairobi; FIT has co-operated with the university since 2014 on the Information System Security Master's study programme.

NEW SHOWROOM ▲

How to show robots what to do? Will surgeries without scalpel ever be possible? And how to link up smart households? These are just some of the questions answered in the Faculty of Information Technology's showroom opened in late August. The visitors can get to know the most interesting projects at FIT. The showroom will occasionally be open to public as well, for example during the Science Night.

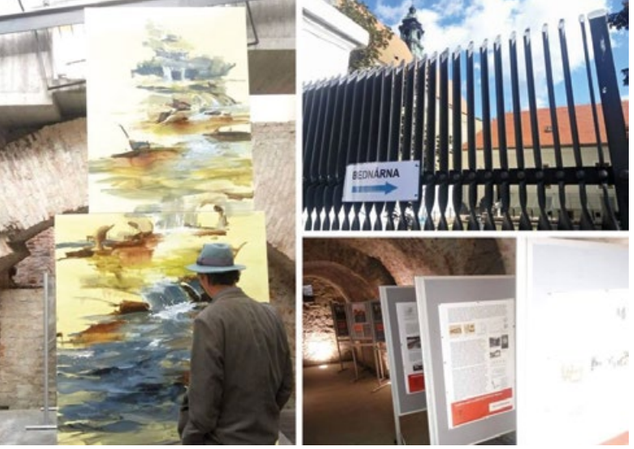
(F)IT SUMMER SCHOOL FOR GIRLS ▼

A week long summer school for elementary and secondary school students, where the girls can learn the basics of programming, will be introduced to graphics and photography editing, but will also visit IT companies where they can meet women professionals working in IT.

1 2 3 4 5 6 7 8 **9** 10 11 12

15–17 September
START@FIT ▼

Traditional event to welcome freshmen as well as other students in the new semester. Start@FIT contains lectures, meeting with academics, faculty tour, but also board games tournament, a game to get to know the Brno centre, music, and an afterparty.



16 September
ARMORIAL CELEBRATION IN KRÁLOVO POLE

A commemorative tour of the refurbished premises of the faculty was held in the premises of the Carthusian monastery, accompanied by the performance of the Lumír choir to celebrate the 109th anniversary of granting coat of arms to Královo Pole. In the oldest parts of the complex, the cooper's workshop, large-format paintings by Jan Spěváček were displayed, as well as the "History of BUT" exhibition and the presentation of the Organ Association in Královo pole.

BEST TEACHERS

Aleš Smrčka for Bachelor's and Tomáš Vojnar for Master's degree studies. These are the most popular teachers at FIT, as the students decided in the best teacher competition announced by the Rector of BUT. The awards ceremony took place on 21 November.

6 October
SCIENCE NIGHT

Almost 700 visitors of FIT during the Science Night could try sitting in the cockpit and try flying a Boeing in a simulator, assembling their own robot, or getting carried away by virtual reality. They could also visit the showroom containing the most interesting technologies that are being developed at FIT, and also some of the specialised workplaces. In the courtyard, RUDA the rescue robot was showing off its abilities. At the Museum of Information Technology, the visitors could have a look at what computers looked like 50 years ago.

9–13 October
FIT AT THE INTERNATIONAL ENGINEERING FAIR

At the International Engineering Fair in Brno, the faculty presented a device for scanning the eye fundus that can automatically set up the lighting intensity and focus. Ophthalmologists may use it to determine the diagnosis based on image data, but it can be used by other experts, too, such as in the area of biometric security systems - the device can recognise people based on their retina.

SERVERS FROM FACEBOOK

Computational photography, mining information from speech, or image and video processing. These are just some of the projects in which the high-performance servers provided to the faculty by Facebook in October will help the research teams of the Faculty of Information Technology of BUT. In 2016, Facebook selected the FIT scientists along with 14 other major research groups from Europe, and included them in the FAIR (Facebook Artificial Intelligence Research) programme, which aims to accelerate the advances in the area of artificial intelligence.

The high-performance servers will help the FIT researchers manage computational operations faster.

START OF THE COURSES FOR SECONDARY-SCHOOL STUDENTS

What dangers are hidden on the web and in the systems? Is the Big Brother really watching us? What data are being read and collected? How do biometrics work? These questions and others were answered in the six seminars organised by the Faculty of Information Technology for secondary-school students. The courses focused on IT and security started in October, continuing with one seminar every month.

13–15 October
MEMICS

The twelfth annual doctoral workshop on mathematical and engineering methods in computer science.

4–5 November
OPENALT CONFERENCE

The conference on open society focuses on topics such as online security and privacy, open source-software and hardware, open public administration data, promoting open access to scientific information, and online map creation OpenStreetMap.

13 November
ŠIMON PÁNEK'S LECTURE AND THE PEOPLE IN NEED EXHIBITION

In 2017, the People in Need humanitarian organisation celebrated 25 years of its activities. On this occasion, a lecture of its co-founder and director Šimon Pánek took place at the Faculty of Information Technology, as well as an exhibition of photographs documenting the quarter-century of the organization's activities.

10 November
ROBOTICS FOR BEGINNERS

The seminar presented ROS (Robotic Operating System) and its application on different robotic platforms. Those who attended learned the basics of how to use ROS and got the idea of how useful it might be for software development in the robot research team.

20 November
ALUMNI 25

MEETING OF GRADUATES AFTER 25 YEARS (see more in the Graduates section, page 55).

18 December
OPEN DOORS DAY FOR THE PROSPECTIVE STUDENTS

INTERSPEECH 2021

Great news arrived to FIT during the Christmas break – Interspeech, the biggest speech conference in the world, is moving to Brno in 2021. The International Speech Communication Association (ISCA) accepted FIT's offer, and the conference will be held in Brno after Hyderabad (India, 2018), Graz (Austria, 2019), and Shanghai (China, 2020).

Events in the spotlight

Excel@FIT presented smart parking solutions and testing of Wi-Fi connection security

Smart parking as an integral part of smart cities. That is the focus of Václav Stránský's, who is a student at the Faculty of Information Technology of BUT, contribution to the Excel@FIT IT conference. In the future, this new parking system should allow drivers to locate a free parking space as soon as possible without having to drive around the entire car park, saving not only time, but also reducing unwanted emissions. The smart parking project is one of over sixty innovative solutions presented by students of the informatics at the third year of the popular Excel@FIT conference held on Wednesday 3 May 2017.

"Effective parking solutions are inherent to the concept of smart cities. Detection of free parking places not only makes it easier for drivers to find free space but also reduces unwanted traffic in the car park, thereby indirectly reducing the CO2 production. My work describes a system that knows the occupancy of the parking spaces, which will make the orientation of the drivers much easier, with a very good success rate - over 93%," said the author of the project, Václav Stránský, who studies IT at the FIT in the follow-up Master's programme. His system uses so-called deep neural networks, which offer much higher accuracy than conventional computer vision methods. Moreover, it can work real-time, both on the graphics card and the processor.

"The system also allows for measuring the time of parking and traceability of the parking space occupancy history. I tested the system on records from an actual car park. My thesis was based on assignment by a company which demanded the new system. A new function will soon be added to fit the needs of the customer: an estimated time of vacating a parking space and other advanced statistics of the usage of the parking space," he added.

Apart from Václav Stránský, Petr Dobeš also focused on the area of smart cities and created a transport monitoring system using a 3D model of a passing vehicle with only a few available pictures. A lot of contributions were focused on security this year. Martin Vondráček introduced a practical tool thanks to which people can try how easy (or difficult) it is to breach their home Wi-Fi network. "Nearly everyone can encounter a MitM (Man-in-the-Middle) attack. My tool serves to improve the network security by automatically detecting its weaknesses and is also useful for forensic analysis," explained Vondráček.

This year's expert jury selected a total of 63 student papers that show great potential in innovation, security, robotics, programming languages, modelling, or sound and image processing. "The quality of the contributions increases every year. It is clear that students are interested in offering innovative solutions in a wide range of information and communication technologies," added Vítězslav Beran, Vice-dean and one of the main organizers of Excel@FIT. After the morning presentation of the twelve best papers, the representatives of professional public and business representatives could see all the posters and prototypes of the new devices in the afternoon, as well as demonstrations of technology provided by partners of the faculty from the industry.

Summer school that support girls in not being afraid of information technology.

Assembling their own digital watch or a Lego-robot, getting to know programming basics, or visitting some of the IT companies in Brno. This rich programme was created for almost 40 attendees of the eleventh (F) IT Summer School for Girls at the end of August. The longest-running event of its kind in the Czech Republic supports girls in order for them not to be afraid of IT, and lasted until 1 September.

The Computer Summer School is aimed at girls between 12 and 19 years of age. Through its project called "FIT sluší dívkám" (FIT fits girls), the Faculty tries to prove that studies of information technologies are not reserved exclusively for men.

"The percentage of women working in IT is still very low, even though many large companies prefer women for certain positions, as they are more capable when it comes to communication, meeting deadlines, and loyalty. IT girls are successful in particular in the area of project management. The (F)IT Summer School for Girls is trying to inform the students about the great opportunities of employment, good salaries, and the possibility of working from home when they have children," said Šárka Květoňová, organizer of the event at the Faculty of Information Technology.

A week long summer school for elementary and secondary school students, where the girls can learn the basics of programming, will be introduced to graphics and photography editing, but will also visit IT companies where they can meet women professionals working in IT.

With only 9%, the Faculty of Information Technology is among the faculties with the lowest representation of women. "The percentage of female students at our faculty is gradually growing, but is still far from satisfactory. The summer school is a great way to support the growth of the number of female students here. Increasing the number of women in research, which is highly desirable and supported throughout the scientific world, cannot be guaranteed in any other way than by increasing the number of university-educated women. FIT has a science programme as well as a number of projects that are potentially very attractive for female students. That is why the Faculty considers the (F)IT Summer School for Girls programme an integral part of the long-term plans of the faculty. The validity of this approach has been confirmed by the 10 successful years of the event," says Pavel Zemčík, the Dean of the faculty.

Among others, Scio statistics also show that it is unnecessary for women to fear the field of IT. "The average percentile of female applicants to the Faculty of Information Technology of BUT is even higher than in the case of male applicants. In the general study potential test, women achieved a percentile of 63.8 on average, while men had an average percentile of 62.1," said Scio spokesperson Markéta Majerová.

Even this year's BUT campaign Sem patřím (I Belong Here), which was awarded as the best marketing campaign of all EUPRIO European universities focused on the lack of women in technical fields. As a part of the campaign, among other things, the university launched the www.technickyvzato.cz website where younger girls can write any questions to the ambassadors of the individual BUT faculties.

Campus

How does it feel to study future technologies in a 14th century monastery? The campus is a unique combination of carefully reconstructed historical premises and new, modern buildings.

Not many universities can say that its premises are listed as a chateau and are used meaningfully. The base, as well as its dominant feature, is the reconstructed Carthusian monastery whose south wing was replaced by a modern compound of lecture rooms. An extensive library with other facilities, offices of the software departments, faculty management and the Museum of Information technology are placed in the historical core. Significant scientists and teachers can now be accommodated in the rooms where the Carthusians used to live.

The over-ground footbridge connects the monastery with the premises of individual departments which house classrooms, laboratories, teachers' offices, and underground parking. The premises are connected to the reconstructed monastery brewery, which now includes catering facilities (restaurant, canteen), student club, theatre hall, exhibition space and accommodation.

The newest building is the Research Centre of Information Technology. The Centre provides space for the supercomputer access point technology and a high-quality work environment for researchers with access to state-of-the-art technology. The centre is then connected to a small castle with offices for doctoral students and for science and research co-operation.

There are also the monastery gardens surrounding the historical enclosure and the park with a café, both accessible to public.

THE PREMISES in 2017

- repairs and reconstruction **CZK 4.8 million**
- new equipment **CZK 948 thousand**
- servicing and maintenance **CZK 3.1 million**
- audiovisual technology renewal within the IMSIT project:
  – investment from the project **CZK 5.8 million**
  – internal resources **CZK 2.5 million**

HISTORY

with a rich building development. After the reforms imposed by Joseph II at the end of the 18th century, the monastery was owned by the army who used it until 1962, which was when the Brno University of Technology got hold of it and located its Faculty of Electrical Engineering there. After the faculty split in 2002, which led to establishment of the Faculty of Electrical Engineering and the Faculty of Information Technology, the then unsuitable facility was assigned to FIT. The renovation and construction works were carried out between 2006 and 2013, giving the leading Brno architects an opportunity to utilise the most recent findings on creating university teaching areas. Thanks to the extensive reconstruction and construction, Brno University of Technology now has one of the most beautiful facilities complying with the most demanding functioning criteria for modern, technically oriented university.

THE LIBRARY

The faculty's library is open 55 hours a week, and offers over 20 thousand library units, study area for 100 students, and 20 computers and terminals. The students can use the library's area of 688 m2 located in the oldest and most valuable part of the monastery as a study room, both for studying individually and for groups.

- **library units as of 31 December 2017** 20,500
- **number of new / removed items** 605/95
- **number of active users** 1,568
  (2,431 registered users)
- **number of loans in 2017** 10,157
- **funds for purchases toward the collections** CZK 600,000

MUSEUM

The Information Technology Museum was established at the Faculty of Information Technology's campus five years ago. Today, the collection includes almost fifty various, mostly personal computers accompanied by about thirty peripheral devices.

The collection displayed is the partly the property of the faculty, however, various exhibits are there on a long-term loan from private collectors and faculty employees.

EXHIBITION

is open to public every first business day Wednesday from 1 p.m. to 5 p.m.

Scientific, research and creative orientation	★★★★★
International openness and attractiveness	★★★★★
Regional development and social inclusion	★
Number of applicants for study and the academic standard of students	★★★★
Evaluation of studies, courses and academic staff	★★★★
Focus on practice and further education	★★★★★
Employability of graduates	★★★★★

Source: Education Policy Centre of the Faculty of Education of Charles University

FIT ranked among the top 10 faculties in the Czech Republic

The Faculty of Information Technology was ranked among the top 10 faculties in the Czech Republic in 2017 by experts from the Education Policy Centre. It was awarded the maximum number of points in the following categories: scientific, research and creative orientation, international openness and attractiveness, focus on practice and further education and employability of graduates.

The Faculty of Information Technology offers education of professionals in the following degree programmes: three-year Bachelor's degree programme (Bc.) Information Technology, two-year follow-up Master's degree programme (Ing.) Information Technology and a doctoral degree programme (PhD.) Computer Science and Engineering.

Bachelor's studies

Information Technology

The Bachelor's degree programme offers education in a modern interdisciplinary field and its graduates have a wide range of career opportunities, ranging from analysts, programmers, testers, maintenance specialists of various software systems or designers and developers of computer systems and networks to interdisciplinary applications of computer-based technology and managers and entrepreneurs in ICT. The programme also provides a solid base for further studies – graduates may pursue study programmes for future teachers, researches or scientists.

Master's studies

Information Technology Security
Bioinformatics and Biocomputing
Information Systems
Intelligent Systems
Mathematical Methods in Information Technology
Computer Graphics and Multimedia
Computer and Embedded Systems
Computer Networks and Communication

Students of the follow-up Master's degree programme deepen their knowledge and specialise in a study field of their choice. They acquire analytical and designer skills that allow them to look for career opportunities as creative specialists in the following fields of information technology:

Doctoral studies

Computer Science and Engineering

The doctoral degree program offers outstanding graduates of the Master's degree programme a chance to gain the highest possible and prestigious qualification in the fields of computer science and engineering and information technology. Organisation of the doctoral programme depends on the topic of the doctoral thesis. Doctoral studies are hugely based on research and active participation in scientific conferences and study stays at universities abroad.

Number of students

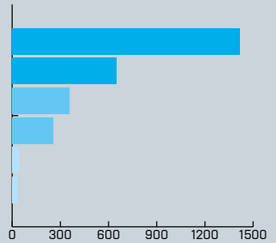
Bachelor's studies	**1 598**
follow-up Master's studies	**540**
Doctoral studies	**168**
Total	**2 306**

Number of applications

Bachelor's studies
number of applications **1 417**
number of registered students **651**

follow-up Master's studies
number of applications **354**
number of registered students **255**

Doctoral studies
number of applications **44**
number of registered students **32**



Subjects

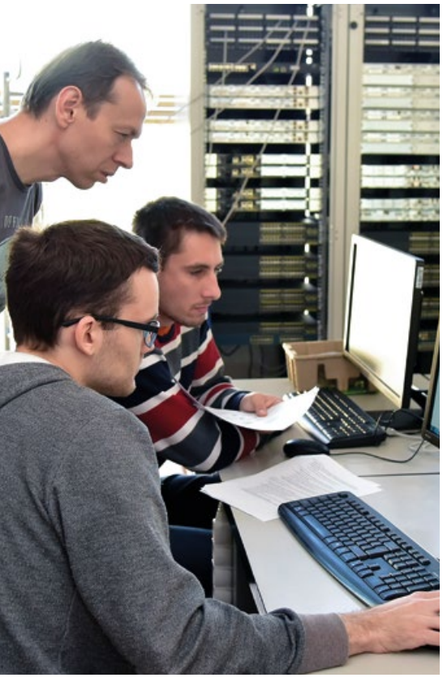
200 courses taught

new courses in 2017 – taught in Czech:

- **Programming Apple devices**

Subject newly taught in English:

- **Application Development for Mobile Devices**
- **Advanced Computer Graphics**
- **Visualisation and CAD**
- **Robotics**
- **Complexity**



List of defended doctoral theses:

- **DITTRICH Petr**
  Light Airplane Flight Parameters Estimation
- **DOLÍHAL Luděk**
  Testing of generated C compilers for processors in embedded systems
- **DRAHOŠOVÁ Michaela**
  Coevolution of Fitness Predicotrs in Cartesian Genetic Programming
- **DYTRYCH Jaroslav**
  Semantic Annotation of Text
- **FIEDOR Jan**
  Practical Methods of Automated Verification of Concurrent Programs
- **HÁJEK Josef**
  Biometric system for retina and iris recognition
- **HRBÁČEK Radek**
  Automated Multi-Objective Parallel Evolutionary Circuit Design and Approximation
- **JURNEČKA Peter**
  Design Patterns for Parallel and Distributed Systems
- **KADLČEK Filip**
  Design and optimisation of image classifiers
- **KEKELY Lukáš**
  Software-Controlled Network Traffic Monitoring
- **KOCINA Filip**
  Advanced Electronic Circuits Simulation Methods
- **MIČULKA Lukáš**
  Methodology for Fault Tolerant Systems Design into Limited Implementation Area in FPGA
- **POLČÁK Libor**
  Lawful Interception: Identity Detection
- **POLOK Lukáš**
  Accelerated Sparse Matrix Operations in Nonlinear Least Squares Solvers
- **SOUKUP Ondřej**
  Formal Models of Distributed Computation
- **SVOBODA Pavel**
  Image Restoration Based on Convolutional Neural Networks
- **ŠEBEK Michal**
  Mining Multi-Level Sequential Patterns
- **ŠOLONY Marek**
  Scalable Multisensor 3D Reconstruction Framework
- **ZÁMEČNÍKOVÁ Eva**
  Formal Model of Decision Making Process for High-Frequency Data Processing
- **ZELENÝ Jan**
  Web page segmentation utilizing clustering techniques

Students' Union of the FIT

The Student's Union of the FIT is a students' organisation at the Faculty of Information Technology. Its main aim is to inform students about important events at the faculty and give them useful information not only for their successful studies but also for their life in Brno.

The Students' Union co-organises many different events. Here are some examples from 2017:

- Rock@FIT
- Closed Doors Day
- Ball of the Students' Union of the FIT
- board and video games tournament
- thematic events in the students' club U Kachničky: Halloween, Christmas, guitar nights; traditional Nordic students sittnings "Sitsit"
- meeting of the FIT academic community
- Science Night
- Open Doors Day
- Start@FIT and "Brnoing": getting-to-know-Brno game

"We are an association of students who care about what is happening at the faculty – we want to be involved in the decision-making that affects the students, represent them and protect their (which means also our) interests. We also organise all kinds of events – be it just for fun or to get a rest from all the schoolwork, but also events focused on further education."

Chairwoman of SU FIT **Kristýna Jandová**
First Vice-Chairman **Marek Václavík**
Second Vice-Chairman **Michal Kotoun**

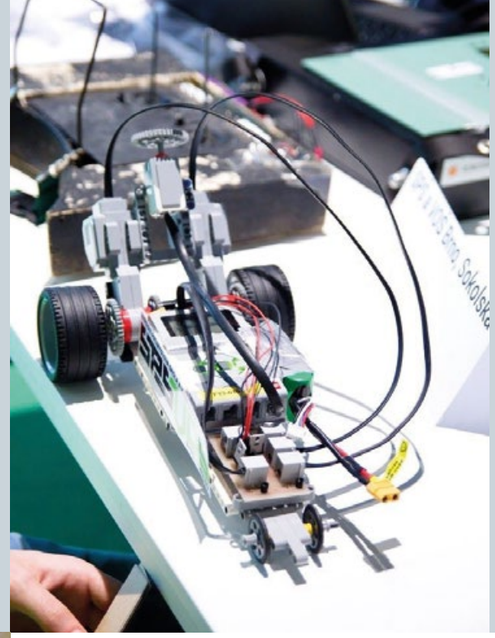
FIT for Teenagers

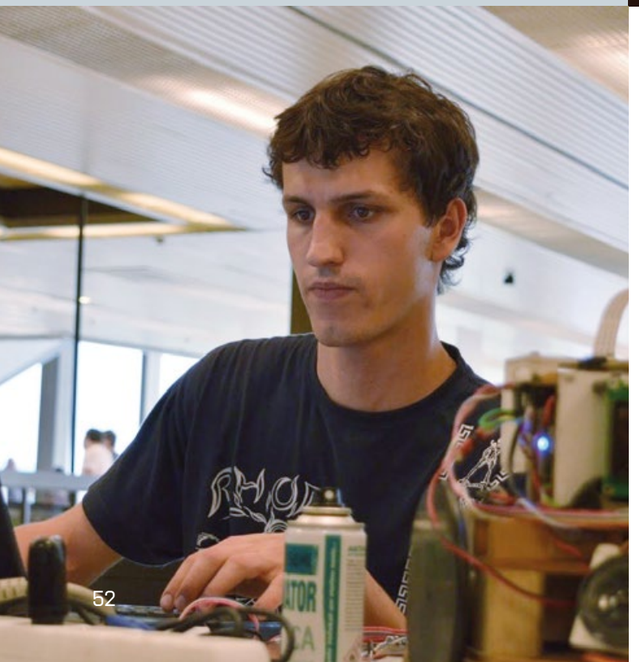
Apart from the traditional Summer School for Girls, the oldest event of its kind in the Czech Republic, whose 11th year took place in 2017, the faculty also organises courses for secondary school students. During these courses, leading experts discuss with the students the issue of security of computer and embedded systems, security on the internet as well as network security and security in robotics. Students get to try a number of practical things during the seminars – from creating a chat application to analysing a mobile phone audio recording and state-of-the-art biometric procedures for screening a 3D face model. Nearly sixty secondary-school students attend the course.

Students in the spotlight

Jaroslav Páral from the FIT teaches children how to build their own robots

Programming and building robots was simply not enough for Jaroslav Páral, who decided that he does not want to keep all his knowledge just to himself. The student of the Faculty of Information Technology now helps pupils broaden their technical skills and knowledge. His "Robotárna" project (Robot Factory) includes interest groups and summer camps for children of all age categories.



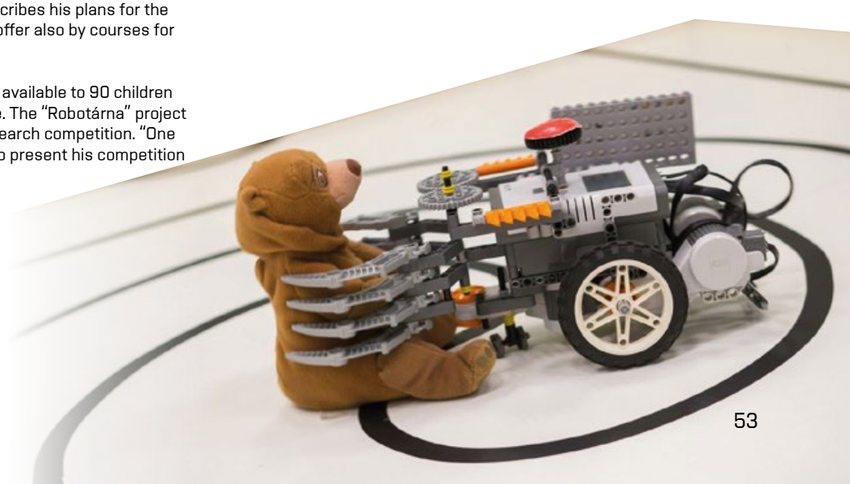


"I have been interested in physics and electronics since primary school, so a secondary school of mechanical engineering was my first choice. At that time, I became involved in a local robotics club. My interest gradually shifted from electronic devices to programming, hardware development and robotics," Jaroslav Páral describes his beginnings in the tech world.

Thanks to the success of his work in the Secondary School Research competition, he got into a programme for gifted students under the South Moravian Centre for International Mobility in 2013. He later came up with the idea that he could pass on everything that he has learnt to others and started working as a lecturer of robotics interest groups and summer camps within the "Robotárna" project. These are intended for primary-school pupils and secondary-school students regardless of their previous experience. "Our interest groups have various levels according to the children's knowledge, from basic to more advanced courses," says Páral. In his courses, the computer science student teaches mostly the basics of electronics and mechanics, programming and designing in 3D programs as well as working with Lego Mindstorms.

And which age category does he prefer to work with? "I usually work with secondary-school students because I am closer to their age. On the other hand, primary-school pupils tend to be more enthusiastic. Older students generally have more interests, so they are not all that eager to work."The interest groups are most popular with pupils and children from the seventh year of primary school to the first year of secondary school. Jaroslav Páral describes his plans for the future: "We are now planning to expand our offer also by courses for university students and adults."

This year, there are about 15 interest groups available to 90 children and a robotics summer camp is to take place. The "Robotárna" project is also involved in the Secondary School Research competition. "One of the participants of our courses even got to present his competition work in Beijing and the United States."



Presenting your own work should be fun – knowing how to talk about your research is key today, says the winner of the 8 of BUT competition

The winner of this year's 8 of BUT competition is David Kozák from the Faculty of Information Technology. He presented his Bachelor's thesis called Fine-Grain Noise-Injection Heuristics for SearchBestie Infrastructure before a panel of experts. The jury awarded him especially for his presentation skills as David was able to explain a very complex issue in just ten minutes using only pictures and jokes. He believes that all students should train their presentation skills. According to David, explaining your work clearly and comprehensibly is one of the key success factors in today's world.

In his first year, student of the FIT BUT David Kozák attended the course Project Practice. That is where he first got acquainted with testing of multithreaded programs and he later chose this issue as the topic of his Bachelor's thesis. "The name of my Bachelor's thesis was rather cryptic and complex. Put simply, I was basically doing some practical testing. In more specific terms, I tested multithreaded programs written in the Java language. Generally speaking, testing is the process of searching for errors in software and consequently improving its quality. However, errors in multithreaded programs are very specific as they occur under special circumstances and it is very difficult to detect them by ordinary tests. And even if found, there is often no easy fix," explains David Kozák.

Experts from the FIT BUT have been looking into this area for several years now and they have developed their own tool for testing these programs – SearchBestie. "In order to increase the chances of spotting an error in a multithreaded program, you have to expose it to special circumstances. Stress the program. Just as people make more mistakes when in stress, this program also tends to do make errors when facing an unexpected situation. However, SearchBestie only searches state space. It does not launch the tests or deal with bytecode instrumentation. That is why we used the ConTest tool from IBM. However, its development was discontinued and the validity of the licence expired, so we had to look for a convenient alternative," continues Kozák. First, his thesis focused on connecting SearchBestie with the RoadRunner program, the latter of which he chose as replacement for ConTest, and then he proposed new heuristics, which allow stressing the tested program in the specific parts of the code selected.

David Kozák says: "There is a number of ways how you can stress the program and it might prove difficult finding the one that actually helps detect the errors. In fact, there are many types of stress that actually mask the error. That is why I was looking for ideal configurations that would help. Normally, the program is tested in randomly chosen parts. But experiments show that precise heuristics achieve better results than heuristics based on randomness."

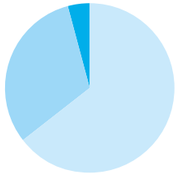
Not only did he successfully defend his thesis but he also won the 8 of BUT competition. David Kozák had only ten minutes to explain what he studied in his work to the expert jury and other competitors. His presentation was so captivating that he won the first place. "I was really shocked, I did not expect to win at all. There was a great group of people and all the theses presented were very interesting. Compared to looking for a cure for Alzheimer's or cancer, my couple of lines of code seem insignificant," says Kozák. He also noted that the jury did not judge the theses as such but rather the presentation and comprehensibility of the research problem being explained. "I wanted to do something less conventional. My colleagues had traditional formal presentations. Since the time was tight, I decided to go for humour. There was almost no text in my presentation. Only the title and two or three things but the rest were just pictures that I commented. I even managed to make the audience laugh a couple times," remarks Kozák.

All competitors attended training on their presentation skills before the final round.

David Kozák believes that such training should be available to all students. "IT experts in particular are often introverted and rather unsociable. I think that you need to work with that. Offer seminars on communication, management of people, presentation skills. Today, it is more important than ever to know how to present yourself and speak about your work. I believe many students at the faculty would appreciate it. If you are to get better in something, you need training," concludes David Kozák.

GRADUATES

Number of graduates



Bachelor's studies	315
follow-up Master's studies	153
Doctoral studies	20
Total	488

Homecoming

Graduates had a chance to meet with their former classmates as well as professors during the Science Night that took place on 6 October 2017. Visitors could look at the results of the FIT in a showroom, explore the historical cellars, share their latest experience from practice and network with others.

Alumni 25 – homecoming after 25 years

Graduates who successfully completed their studies in 1992 at the Department of Computer Science and Engineering of the then Electrotechnical Faculty of BUT returned to their alma mater in November, after 25 years. They had a chance to see what is new at the faculty, meet with their former classmates and professors, reminisce about the old times for a bit and also network with others or learn about the possibilities of cooperating with the university.

Graduates in the spotlight

Artificial intelligence will just complement natural intelligence, nothing more, says Mikolov from Facebook


Photo: Facebook

Tomáš Mikolov talked about neural networks, artificial intelligence as well as his work for Google and Facebook at the beginning of January at the Faculty of Information Technology of BUT. He developed a program now used by Google while he was still studying at BUT. His works have been cited more than 11,000 times by other scholars. He now works as a research scientist for Facebook, researching artificial intelligence. He says that progress in this field is very slow and we still have very little benefit from ideas that people came up with decades ago. Mikolov says that we do not have to worry that artificial intelligence will conquer the world. He believes that technology will only complement our existing capabilities.

Tomáš Mikolov started his glittering career ten years ago with his Master's thesis on a program for vector representation of words. "I was looking into natural language processing and representation of words. The fact that similar words have similar vector representation has a number of applications, for instance in text classification. This can be used for detecting whether certain messages or e-mails are spam," explains Mikolov. In his Doctoral thesis, he was the first one to train language models based on recurrent neural networks and thus improve automatic speech recognition systems and machine translation.

His algorithms are now used, for example, by Google, Microsoft, Facebook, IBM or Twitter and they have many other applications, including improving search engines and machine translation. They are available for everyone for free on the internet under the names RNNLM, word2vec or fastText.

In his subsequent work, Mikolov showed that if you calculate the vector representation of words and teach the computer that words found in similar context have similar vectors, then you can translate from one language to another without having to understand the language. "In Google, I worked with a Vietnamese scientist and I was able to train models also using Vietnamese without knowing a single word of this language. When I needed to verify that the program generates meaningful results, I asked him to read it," explains Mikolov, who has now been working in international teams in the US for five years. We should soon notice improvements in online translation tools that will translate whole sentences more accurately and with correct cases or gender.

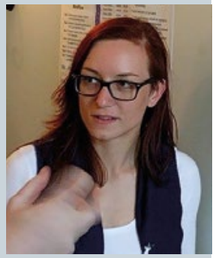
Mikolov: sci-fi scenarios about robots taking over the world are far-fetched

His work is considered ground-breaking especially due to the fact that he was able to replace hundreds of computers. "Many people and companies believed that these vector models must be trained on a big number of computers. It does make sense in many cases. If you have a service intended for a billion people, you cannot run it on a single computer. However, the solutions for vector representations were indeed overly complex. The program I came up with during my studies at BUT and later further developed in Google works very efficiently. It was able to learn from one hundred billion of words in three hours on just one computer," says Tomáš Mikolov.

Even though his results might seem impressive, Mikolov himself remains rather sceptical. He says that if you look, for instance, at progress in artificial intelligence development, which is exactly what he does at the moment in Facebook, it is much slower than laymen might think. He believes that popular scenarios about robots taking over our world in the near future are far-fetched science fiction. "People will always have to give the initial impulse to AI and focus its attention on a concrete problem. We have to determine what the given technology should do and what data it should process," continues Mikolov, who hopes to do research on his own in the future, without large corporations at his back. "Even though working for Google or Facebook might seem as a dream come true, you have to deal with a lot of bureaucracy and politricks. I would rather dedicate my time to research and faster progress," concludes the successful scientist.

FIT graduate Drahomíra Herrmannová: the bulk of knowledge that we have is growing so fast that people are no longer able to classify it

What exactly are hundreds of thousands of scientists all over the world working on and is their research of good quality? These questions could be answered in just a few moments by a system being developed by Drahomíra Herrmannová, graduate of the Faculty of Information Technology, and her colleagues.



She is currently preparing to defend her PhD thesis at the Knowledge Media Institute in the UK, where she studies methods of classifying research publications and machine evaluation of their quality. According to Herrmannová, the bulk of scientific knowledge that we have is growing so fast that individual scientists can no longer keep track of the latest developments in their fields of expertise and of what might be of interest to them. She is planning to return to the Oak Ridge National Laboratory in Tennessee in the US after finishing her studies, where she has been carrying out her research.

Drahomíra Herrmannová first experienced living abroad and doing research – something that she has now been doing for four years – during her study visit in Portugal. Currently a PhD student, she describes her beginnings as follows: "I went to Portugal during my Bachelor's studies and I loved it so much that I started looking for another opportunity to stay abroad as soon as I got back home." During her Master's studies, she was selected for an internship in the UK, where she met her current doctoral advisor and discovered the topic of machine classification and processing of research publications. "The problem is that science today is progressing at an unprecedented rate – scientists produce large quantities of research papers and there is no way to keep track of all of them. Even if you just want to know what other scientists in your field are doing, it is very difficult or even impossible," explains Herrmannová.

That is why she and her colleagues are looking for ways of using technology for the benefit of science. She explains: "We want to be able to extract text from articles and then get certain information from the text by automated means." In the distant future, artificial intelligence could become intelligent enough to understand text and derive new information from it. But until then, researchers in computer science want to offer other solutions for classifying information and extracting the most relevant parts of it. "Not long ago, we worked on a joint project with materials scientists in the US, who specialise in specific materials. They wanted to know who else in the world is doing research on the same topic and at what temperatures they performed their experiments. We downloaded all available research papers in the given field and found at which temperatures other scientists did their research. The American team could then focus on analysing materials at temperatures that have not yet been studied," describes Drahomíra Herrmannová.

In her doctoral thesis, she herself also looked into research publication quality. "When I was an intern in the UK, I worked as a software engineer and helped develop a system that would collect and retain all scientific publications in the world. Later, a new requirement emerged – we were supposed to add new functions to the system to facilitate searching. One of them was quality assessment. The aim of my PhD thesis was to find an automated method for determining whether research outcomes are of good quality and why. Today, quality is evaluated based on the number of citations of the given paper, which is not a good measurement method. It is the same as if I said that the film was good because many people watched it," says Herrmannová.

Contrary to conventions, Drahomíra Herrmannová chose a new method for evaluating research called semantometrics. Herrmannová describes the system: "We measure the degree of similarity or dissimilarity between the new text and the cited publication. If a paper is cited in other publications but it does not really bring anything new, then it is considered of lower quality than a paper cited also in other fields. So if you discover a new material and your research publication is then cited also in texts on biology, then your publication is automatically of good quality, since it has implications also in other disciplines."

According to Herrmannová, the results show that this method of research quality evaluation works very well. "We managed to show that you can automatically extract much more information from a text than just how many times it was cited by someone. It was a challenge to come up with a different mechanism but I am glad that we have succeeded in doing at least the first step," says the young scientist.

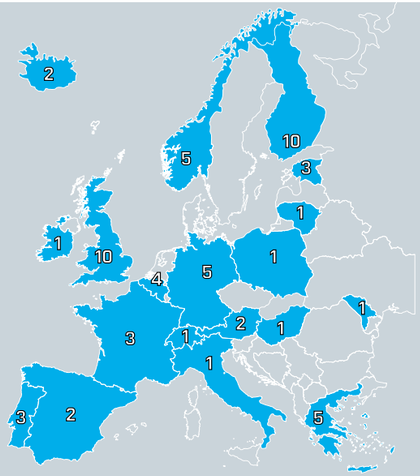
Although her present work goes far beyond her original specialisation, Drahomíra Herrmannová underlines that it was thanks to her studies at the Faculty of Information Technology that she had a great head start at the beginning of her career. "At the FIT, I specialised in software engineering and I have to say that the school is really awesome in this area. I knew all the technical stuff so well that no matter where I was in the world, I had the biggest knowledge base in this respect," remarks Herrmannová, who is not fully focused on completing her studies in the UK. She is then planning to apply for a post-doctoral position at the US National Laboratory that helps scientists from all over the world make their research more efficient.

Gaining experience from abroad is a unique opportunity. Students may take advantage of partner organisations and a number of programmes offered by FIT and spend a part of their studies in another country. And vice versa – the faculty welcomes students from partner institutions who decide to complete a part of their study programme in Brno. Thus, our students have a unique opportunity not only to meet students from other countries but also to establish relationships with people abroad that may be useful in their future professional career.

14,7%
proportion of graduates who participated in a stay abroad during their studies (for at least 14 days)

20%
proportion of graduates of doctoral studies who spent at least 1 month abroad

Number of FIT students going for a study stay abroad in the academic year 2016/2017



Total 66

to China 1

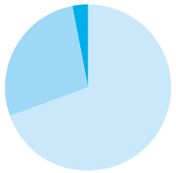
to Japan 1

to South Africa 3

Students coming to FIT in the academic year 2016/2017

from Greece	20	from Malaysia	3	from Poland	1
from Turkey	8	from Malta	2	from Bulgaria	1
from France	7	from Portugal	2	from Nigeria	1
from Spain	6	from Lithuania	2	from Tanzania	1
from Italy	4	from Slovakia	2		
from Taiwan	4	from Germany	1	Total	65

Type of programme

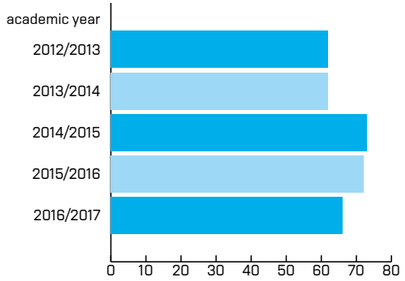


Erasmus + (study) **46**

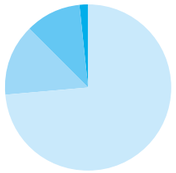
Development programme MŠMT **18**

Erasmus + (internship) **2**

Number of outgoing students – comparison



Type of programme



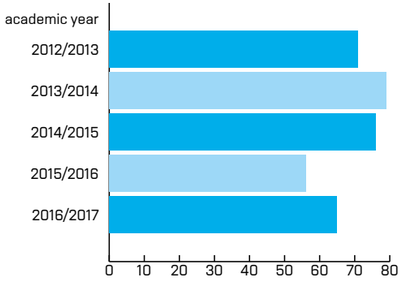
Erasmus + (study) **48**

Erasmus + (internship) **9**

Free mover **7**

Person receiving governmental scholarship **1**

Number of incoming students – comparison



Experience

Pála Ögn Stefánsdóttir, Island

Studium na FIT se mi opravdu líbilo. Brno je krásné staré město s množstvím IT firem a IT kulturou. Brno je také studentským městem, takže se v něm stále něco děje. V rámci programu Erasmus jsem se potkala se spoustou dalších studentů IT z celého světa a hodně se toho od nich naučila. Mezinárodní studentský klub na VUT navíc dělá opravdu dobrou práci a pomohl mi zajistit příjemný pobyt. V Brně se mi líbilo natolik, že jsem si svůj studijní pobyt prodloužila o další semestr.

Kesküla Kullar, Estonsko

Fakulta informačních technologií je naprosto skvělá. Vynakládají veškeré úsilí, aby vám poskytli to nejlepší vzdělání. Brno je navíc velmi příjemné město. Pokaždé, když se po něm procházím, se cítím jako doma.

Newly established co-operation in 2017:

- Université de Caen Normandie, France – Erasmus+
- ESIGELEC, School of Engineering, Rouen, France – Erasmus+
- International Institute of Information Technology Hyderabad, Hyderabad, India
- Sichuan University of People's Republic of China, Sichuan, China

Important visits from abroad

date	name	country	institution
3. 1.	**Mikolov Tomáš, Ing.**	USA	**FACEBOOK**
6. 1. – 27. 2.	**Biswas Sangeeta, Ph.D.**	Bangladesh	**University of Rajshahi**
31. 1.	**Menezes de Oliveira Neto Manuel, Ph.D.**	Brazil	**Federal University of Rio Grande do Sul**
14.–15. 2.	**Pobloth Harald, Ph.D.**	Sweden	**Ericsson AB**
15. 2.	**Didyk Piotr, Ph.D.**	Germany	**Universitaet des Saarlandes**
27.–28. 3.	**Derawi Mohammad O., prof., Ph.D.**	Norway	**Norwegian University of Science and Technology**
29.–30. 3.	**Kozek Martin, prof.**	Austria	**Technische Universität Wien**
21. 4. – 2. 6.	**Kälviäinen Heikki, prof.**	Finland	**Lappeenranta University of Technology**
24. 4.	**Häb-Umbach Reinhold**	Germany	**University of Paderborn**
10. 5.	**Kim Kwawng In**	United Kingdom	**University of Bath**
26.–28. 6.	**Umesh Srinivasana, Dr.**	India	**Indian Institute of Technology Madras**
14. 8.	**Wang Qiongqiong**	Japan	**NEC Corporation**
	Mahto Shivangi, M.Tech	Japan	**NEC Corporation**
26.–28. 8.	**Delcroix Marc**	Japan	**NTT Corporation**
	Kinoshita Keisuke	Japan	**NTT Corporation**
28. 8. – 1. 9.	**Veanes Margus**	USA	**Microsoft Research Redmond**
4. 9. – 12. 11.	**Lozano-Diez Alicia**	Spain	**Universidad Autonoma de Madrid**
2.–6. 10.	**Szabó László F., Dr.**	Hungary	**Eötvös Loránd University, Faculty of Informatics**
	Cumani Sandro	Italy	**Politecnico di Torino**
16. 10.	**Mareček Jakub, Ph.D.**	Ireland	**IBM Ireland Research Lab**
30.–31. 10.	**Han Jie, Dr.**	Canada	**University of Alberta**
1. 11.	**Aydin Tunc O.**	Switzerland	**Walt Disney Studios Switzerland GmbH**
7.–9. 11.	**Trefzer Martin A., Dr., MSc., PhD.**	United Kingdom	**University of York**
21.–22. 11.	**Nagy Benedek, Dr.**	Turkey	**Eastern Mediterranean University**
22. 11.	**Stafylakis Themos**	Canada	**Centre de Recherche en Informatique de Montre**
12.–23. 6.	**Breitinger Frank**	USA	**University of New Heaven**
12.–14. 10.	**James Joshua I.**	Korea	**Hallym University**

07 INDUSTRIAL PARTNERS@FIT

Brno is sometimes referred to as the Czech Silicon Valley. And the Faculty of Information Technology is in the very centre of it. One cannot be closer to the renowned global companies, promising start-ups and excellent research teams.

However, we choose our collaboration partners wisely. We deem it crucial that the scientific and research co-operation of our academics and researchers with the industrial partners is mutually beneficial in the long term.

We are interested in research and application projects with the potential for innovation. We co-operate with the partners with whom we share professional interests on the preparation and implementation of both national and international research projects, as well as direct contractual research.

We allow our long-term partners to establish laboratories or other workplaces within the faculty's premises so as to enable the companies to be in direct contact with the researchers as well as students who may work in such establishments as a part of their studies.

The partners may also co-operate with us in classrooms, where they can present our joint research activities as a part of host lectures or professional seminars. Students may also co-operate with the partners when working on their master's and bachelor's theses as well as study projects for courses.

Co-operation of FIT with its partners

- **joint preparation** of both national and international research projects
- **orders, services and licences** in IT
- **hosting in labs and research workplaces**
- **research topics** with possible participation of students
- **co-operation in teaching**
- **support of faculty events**, conferences and competitions
- **promotions of the partner** at the faculty

In 2017, the following companies were partners of the faculty:

golden partners

CZ.NIC | SPRÁVCE DOMÉNY CZ

CESNET

Honeywell

redhat.

ŠKODA

camea

codasip

PHONEXIA

VR Group

silver partners

3DM Laboratory
3D Digital Imaging and Modeling Laboratory

INNOVATRICS
YOUR BIOMETRIC PARTNER

ROIHUNTER

UNICORN

ARTIN

NXP

ThermoFisher SCIENTIFIC

YSOFT

bronze partners

ALVAO

CYAN RESEARCH & DEVELOPMENT

camvisiON

edhouse
software development

Flowmon Networks

qubi

IMPACT HUB Brno

M.I.T. Consulting

MAVENIR

ON Semiconductor

PONAVIA
vědecko-technický park

RCE SYSTEMS

ReplayWell

sewio

solarwinds

SOLITEA

solution partner

system4u

TBS

TESCAN
PERFORMANCE IN NANOSPACE

UNIS

Zoner

RehiveTech

Contractual research in 2017

60 defended bachelor's / master's theses in co-operation with partners

50 projects as a part of the contractual research

40 industry partners

CZK **30** million, total volume of finances for projects of contractual research in 2017

Selected contractual research projects with partners of FIT in 2017

InPACT – Interactive Recommendations for Pilots in Modern Cockpit Technology
doc. Ing. Peter Chudý, Ph.D., MBA

InPACT is a set of direct contractual research projects at the Faculty of Information Technology ordered by Honeywell International. An intersection of topics following from current research needs of the company and the competence portfolio of the faculty resulted in successful implementation of multidisciplinary projects focused on lowering the pilot's workload, raising situation awareness, acceleration of large data processing algorithms and verification of proposed technologies in fully moveable flight simulator at FIT BUT in Brno.

User Interface of Recharging Stations for Electromobility
prof. Ing. Tomáš Hruška, CSc.

As part of the direct contractual research project, an optimised user interface including a control layer of recharging stations was designed for KPB INTRA s.r.o., a South Moravian producer of recharging stations for electromobility. This design was also implemented into a specific product of the company

Using Network Analysis Techniques to Prevent Data Loss
Ing. Jan Pluskal

As a part of the joint applied research with Safetica Services s.r.o., an analysis of current approach to detection of transfer anomalies on the computer network used for detection of internal data leakage from company networks was performed.

Speech Enhancement Front-end for Robust Automatic Speech Recognition with Large Amount of Training Data
doc. Dr. Ing. Jan Černocký

The aim of the joint research with the Japanese company Nippon Telegraph and Telephone Corporation is to develop new technologies of parametrisation with speech enhancement for its robust automatic speech recognition with a large volume of training data as a part of the co-operation of BUT and NTT. The thesis is based on low-dimensional data representations produced by neural networks in different parts of the processing chain.

Speech@FIT group and Phonexia co-operated on speech recognition for Arabic
doc. Dr. Ing. Jan Černocký

The aim of this co-operation was to develop a system for automatic transcription of speech in Arabic, more specifically the Gulf Arabic dialect. Speech@FIT group prepared an acoustic model based on data supplied by Phonexia.

With regard to Arabic speaking areas, recognition of Arabic dialects is of a substantial commercial potential. On the other hand, it also poses a great research challenge as the Arabic dialects often have no established written form. In order to complete the task, good knowledge of linguistics and machine learning offered by the speech group was necessary.