

Registration form for Polish scientific institution

1. Research institution data (name and address):

Faculty of Mathematics, Informatics and Mechanics
University of Warsaw
Krakowskie Przedmiescie 26/28
00-927 Warszawa.

2. Type of research institution:

1. Basic organisational unit of higher education institution

3. Head of the institution:

dr hab. Maciej Duszczyk - Vice-Rector for Research and International Relations

4. Contact information of designated person(s) for applicants and NCN

(first and last name, position, e-mail address, phone number, correspondence address):

Prof. dr hab. Anna Gambin,
Deputy dean of research and international cooperation,
Faculty of Mathematics, Informatics and Mechanics,
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5. Science discipline in which strong international position of the institution ensures establishing a Dioscuri Centre (select one out of 25 listed disciplines):

Natural Sciences and Technology disciplines:

Computer science and informatics

6. Description of important research achievements from the selected discipline from the last 5 years including list of the most important publications, patents, other (up to one page in A4 format):

The institution and its faculty. Institute of Informatics at MIM UW is the leading Polish institute of computer science and one of the islands of excellence on the map of Polish science. Our strength arises not only from past achievements, but also from on-going scientific

activities that attract new generations of young computer scientists from the whole of Poland and from abroad. The following is a non-exhaustive list of important results published no earlier than 2014 obtained by researchers from MIM UW. Research articles based on these results have appeared among other venues, *Ann. ACM/IEEE Symp. on Logic in Comp. Sci., Comm. of the ACM, Jour. of the ACM, Artificial Intel., SIAM Jour. on Comp., Nucleic Acid Res.* Employees of MIM UW have also proposed several computational methods for interdisciplinary applications published in e.g. *Genome Res., PLOS Comp. Biol., Nature Met., Angew. Chem., Anal. Chem.*

Logic in CS. M. Bojanczyk and M. Pilipczuk studied the celebrated *Courcelle's theorem*, published in 1990, stating that every graph property definable in the monadic second-order logic of graphs (MSOL) can be decided by a finite state tree automaton on graphs of bounded treewidth. At the same time Courcelle conjectured a converse implication: if a property of graphs of bounded treewidth is recognized by a tree automaton, then it can be defined in

counting monadic second-order logic. The Courcelle's Conjecture was a subject of active research for 27 years, yet it has been confirmed only in a few special cases. The work of Bojanczyk and Pilipczuk shows that the conjecture is true in general.

Cryptography. S. Dziembowski and his collaborators developed a method to use *Bitcoin* (digital currency) system as a framework for secure multiparty computations. They proposed decentralized protocols that are secure even if no trusted third party is available and constructed

protocols for secure multiparty lotteries using the Bitcoin currency which guarantee fairness for the honest parties no matter how the loser behaves.

Algorithms. M. Cygan and his collaborators introduce a general framework for solving problems

on weighted graphs without negative cycles using matrix multiplication. The framework is based on the usage of *Baur-Strassen's theorem* and of Strojohann's determinant algorithm. The authors obtain a few breakthrough algorithms for fundamental problems like finding a minimum weight perfect matching, computing graph diameter or finding the shortest cycle. The computational complexity of *graph isomorphism* was studied by M. Pilipczuk and his collaborators. It is well known that this problem has a polynomial time solution on trees, and researchers extended this to graphs of bounded treewidth, i.e., graphs similar to trees. Unfortunately the exponent of the polynomial grows with treewidth. It was an open problem whether this growth can be avoided. The authors answer this question affirmatively.

Computational Biology. A. Gambin's team in collaboration with P. Stankiewicz (Huston) demonstrated that, in contrast to currently presumed knowledge, *Non-Allelic Homologous Recombination* mechanism can be induced by much shorter homologous sequences than it was thought. It was verified that *transposable elements*, which cover a highly significant part of the genome can induce such rearrangements. The results strongly reverberated in the scientific community, since they diametrically change the way one can think about the stability of the human genome.

7. List of no more than 3 important research projects from the selected discipline awarded in national and international calls to the institution in the last 5 years

(title, name of PI, source of funding, amount of funding):

– *A unified theory of finite-state recognisability*

PI: prof. Mikołaj Bojanczyk

European Research Council (ERC)

ERC Consolidator Grant,

budget: 1 768 125 EUR.

– *owards unification of algorithmic tools*

PI: prof. Piotr Sankowski

European Research Council (ERC)

PI: prof. Piotr Sankowski ERC Consolidator Grant,

budget: 1 510 800 EUR.

– *Cuts and decompositions: algorithms and combinatorial properties*

PI: Marcin Pilipczuk, phd

European Research Council (ERC)

ERC Starting Grant,

budget: 1 228 250 EUR.

8. Description of the available laboratory and office space for Dioscuri Centre (up to one page in A4 format):

The unique location of Faculty of Mathematics, Informatics and Mechanics of the University

of Warsaw at the Ochota campus surrounded by the departments of Physics, Chemistry, Biology, and several excellent institutes of Polish Academy of Sciences, fosters fruitful interdisciplinary cooperation. Computational resources allocated for Dioscuri Centre comprise air conditioned server rooms as well as computer laboratory with number of PCs. Overall surface is around 70 square meters. Office space allocated for Dioscuri Centre consists of: 3 single person office rooms (12 square meters), 2 double office rooms (20 square meters), 1 office room for Phd students (40 square meters), 1 administrative office (288 square meters) and other necessary facilities.

9. List of the available scientific equipment for Dioscuri Centre:

The computing infrastructure of the Faculty of Mathematics, Informatics and Mechanics of the University of Warsaw includes servers with sufficiently high power to allocate resources for all research groups created within the framework of Dioscuri Call.

To renew and maintain the infrastructure we use funds from a number of other projects carried out at the Faculty.

10. List of the additional benefits that the Institution declares to provide for Dioscuri Centre (i.e.: additional funds, personal benefits, other) (up to one in page A4 format):

Additional benefits for researchers of Dioscuri Centre include professional service supporting the research activity. The employees of Research Support Office, Financial Section and Office

of Institutes provide advice and assistance with the realization of the project.

The extensive support on management of the project covers all financial and reporting issues, as well as the organization of small and medium-size scientific meetings.

MIM UW department collaborates with the University's technology transfer office that are responsible for assisting researchers to protect and commercialise their Intellectual Property potentially resulted from the research activity of Dioscuri Centre.

Moreover, additional funding will be provided by Dean of MIM UW to support small scientific

meetings, workshops and individual research visits organized by Dioscuri Centre. MIM UW department have an excellent pool of undergraduate and graduate students (each year 50-60 laureates of Mathematics and Computer Science Olympiad choose to study here).

Last but not least, the researchers of Dioscuri Centre are eligible to use the University Sports Centre located on Banacha Street. The extensive facilities include: competition-standard swimming pool and climbing wall.

11. Other information about internationalization of the scientific institution, foreign scientists employed at the institution, availability of the English language seminars etc. (up to one page in A4 format):

Most of the researchers in the Institute of Informatics collaborate with foreign colleagues, what involves regular travels to foreign universities and hosting foreign guests. They regularly publish their work in internationally recognized journals, and are frequently invited as speakers to major international conferences. The successful research is documented by numerous

best paper awards at international conferences (*EUROCRYPT 2014, IEEE S&P 2014, IPEC 2016, PODS 2016, ESA 2017, PODS 2016*). Faculty members serve as program committee

and editorial board members in numerous international conferences (STOC, LICS, SODA, PC chair at ESA'16) and journals (*Algorithmica*, *ACM Trans. Algorithms, Information and Comput.*, *Theor. Comp. Sci.*, managing editors in *Inf. Proc. Lett.*, *Fundamenta Informaticae*).

Some long-term members of the faculty are foreign-born (L. Clemente, Anh Linh Nguyen, Hung Son Nguyen). Many more researchers from outside of Poland come to MIM UW as postdoctoral researchers and phd students. In recent years, support for postdoctoral positions has come mostly from the *Warsaw Centre of Mathematics and Computer Science* (WCMCS, www.wcmcs.edu.pl, a consortium consisting of MIM UW and the Institute of Mathematics of the Polish Academy of Science), which in the years 2012-2017 had the status of a National Scientific Leadership Centre along with associated funding. Other sources of support have included ERCIM (the *European Research Consortium for Informatics and Mathematics*, www.ercim.eu) and individual projects, especially ERC grants.

Researchers from MIM UW also actively involved in the organization of international conferences.

In recent years they were organized some of the world's top conferences in computer science (*RECOMB 2015*, *ICALP 2017*) and numerous workshops and summer schools. Many scientists employed at the Institute are holders of grants intended to support cooperation with research groups from specific institutions outside of the country. This includes first of all ERC grants, but also numerous *Harmonia* grants funded by the National Science Centre, *COST Action* and others EU founded grants. Employees of MIM UW have also taken advantage of the *Polish-French cooperation programme Polonium*.

Essentially all graduate-level courses at the department are offered in English. Many research seminars have foreign participants and are held in English on a regular basis, while all the others can be held in English whenever there is a non-Polish speaking participant. Moreover, for so called *Phd Open* courses the foreign lecturers are invited to present hot research topics for phd students.