

Registration form for Polish research institution

1. Research institution data (name and address):

Faculty of Mathematics, Informatics and Mechanics

University of Warsaw

Krakowskie Przedmieście 26/28

00-927 Warszawa

2. Type of research institution¹:

1) higher education institution

3. Head of the institution:

Prof. dr hab. Alojzy Z. Nowak

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

Banacha 2 02-097 Warsaw, 22 55 44 566,

A.Gambin@mimuw.edu.pl

5. Research discipline in which the strong international position of the institution ensures establishing a Dioscuri Centre:

Computer science and informatics

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

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 ongoing scientific

¹ As specified in "Addressees of the call"

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 2018 obtained by researchers from MIM UW. Research articles based on these results have appeared among other venues, *STOC*, *FOCS*, *LICS conferences*, *Comm. of the ACM*, *Jour. of the ACM*, *SIAM Jour. on Comp.* 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.*, *Nature Comm.*

Logic in CS. M. Bojańczyk with collaborators developed a theory of first-order list functions, which manipulate objects such as lists, lists of lists, pairs of lists, lists of pairs of lists, etc. The functions are constructed by starting with some basic functions (projections, head and tail operations etc.) and putting them together using simple combinators. The main result is that first-order list functions are exactly the same as first-order transductions, under a suitable encoding of the inputs.

Theory of Computation. S. Lasota and W. Czerwiński, in an international cooperation (Warwick, Bordeaux), discovered a groundbreaking construction that proved a novel nonelementary lower bound on the complexity of the reachability problem in Petri nets; the first progress made in this direction for over 40 years.

Cryptography. S. Dziembowski and his collaborators developed Perun, a blockchain-based framework that supports creation of off-chain lightweight channel networks for real-time payments. They proposed decentralized protocols that are secure even if no trusted intermediaries are available, assuming access to an underlying blockchain with support for smart contracts.

Algorithms. M. Cygan and his collaborators obtained breakthrough results for the Hamiltonian Cycle problem. In particular, they have broken the $O(2^n)$ barrier for the time complexity of the bipartite directed case, and showed a new algorithm parameterized by the pathwidth of the input graph, which is optimal assuming the Strong Exponential Time Hypothesis. Piotr Sankowski and his collaborators were able to obtain exponential speed-up for the PageRank algorithm in the Massively Parallel Computation (MPC) model.

Computational Biology and Chemoinformatics. W. Jaworski and A. Gambin with collaborators from the Institute of Organic Chemistry proposed new algorithm for mapping atoms in chemical reactions. The algorithm performs significantly better than the available state-of-the-art reaction mappers and can be applied in database curation and automatic extraction of reaction rules underlying modern synthesis-planning programs.

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):**

1. *TUgbOAT Towards unification of Algorithmic tools,*

ERC Consolidator Grant,

dr hab. Piotr Sankowski, 1 510 800,00 EUR

2. *PROCONTRA Smart-Contract Protocols: Theory for Applications,*

ERC Advanced Grant,

prof. dr hab. Stefan Dziembowski, 2 496 370,00 EUR

3. *BOBR Decomposition methods for discrete problems,*

ERC Starting Grant,

dr Michał Pilipczuk, 1 355 688,00 EUR

8. **Description of the available laboratory and office space for the 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 research equipment for the 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 (other than listed in call text) that the Institution declares to provide for the Dioscuri Centre (i.e.: additional funds, personal benefits, other) (up to one page in A4 format):

Additional benefits for researchers of Dioscuri Centre include professional service supporting the research activity. The employees of Research Support Office and Financial Section 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 the internationalisation of the research institution, international researchers employed at the institution, the availability of 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 (STOC, *EUROCRYPT*, *SODA*, *PODS*). Faculty members serve as program committee and editorial board members in numerous international conferences (STOC, LICS, *SODA*, *ESA*) 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 (ICALP 17, *DLT 19*, *Highlights 2019*) 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.