ARTIQ

ARTIQ - AI Centres of Excellence

Application for a Host Institution

Institution	National Centre for Research and Development, National Science Centre
Project Joint National Project:	ARTIQ – AI Centres of Excellence
Deadline for the submission of applications	8th of April-11th of May 2021

I. HOST INSTITUTION DATA

Identification data of the Host Institution

Name (full)	***University of Warsaw***
Name (short)	***UW***
Name of the main organisational unit (where applicable)	***Faculty of Mathematics, Informatics and Mechanics***
Address of the registered office	
Street	*Krakowskie Przedmieście*
Building No.	*26/28*
Office No.	
Postal code	*00-927*
City/district	*Warsaw*
Post office	*Warsaw*
Municipality	*Warsaw*
County	*Warsaw*
Province	Mazovia

Correspondence address (if different than the address of the registered office)	
Street	
Building No.	
Office No.	
Postal code	
City/district	
Post office	
Municipality	
County	
Province	
EPUAP [Electronic Platform for Public Administration Services] mailbox	***/uwedupl/SkrytkaESP***
Legal form	***Public university***
The person appointed for contact with NCBR and with the potential Leader/Project Manager	
First name	***Anna***
Last name	***Gambin***
Position	***Professor***
Phone number	***(22) 55-44-212***
E-mail address	***sob@mimuw.edu.pl***
The person authorised to represent the applicant	
First name	***Zygmunt***
Last name	***Lalak***
Function/Position	***Vice-Rector for Research***

II. CAPACITY OF THE HOST INSTITUTION TO PERFORM THE PROJECT

1. Description of major research achievements in the scope of implementation of R&D projects, as well as the commercialisation of deliverables of such projects regarding artificial intelligence for the last 5 years prior to or in the year of the application along with a list of the most important publications and patents of the applicant (max. 1 A4 page).

Currently, scientists employed at the Faculty of Mathematics, Informatics and Mechanics of the University of Warsaw carry out over one hundred research projects. The strong position of the Faculty in acquiring funds for research is confirmed by the successes in competitions of the European Research Council (ERC). So far, Polish scientists have been awarded 41 of these prestigious projects, of which as many as 11 went to our faculty.

Many research groups are involved in the field of AI. As part of the robot learning group led by M. Cygan, research is currently being carried out in the fields of image processing and manipulation with a robotic arm.
In the field of explainable artificial intelligence (XAI), P. Biecek developed an Explanatory Model Analysis methodology with implementation in open source libraries for R and python http://dalex.drwhy.ai/. He also dealt with applications in oncology, providing a set of predictive signatures for patients based on data from The Cancer Genome Atlas and developingrecommendation of good practices in creating models to predict changes visible in x-ray and CT images of the lungs.
P. Skowron designed a new system of committee selection (called Rule X) that satisfies strong axiomatic properties describing fairness and proportionality. This system is generalized so that we can use it to select projects under a participatory budget or to make decisions on independent issues.
J. Cyranka conducts research on the methods of interpretability and safety of agents obtained by means of reinforcement learning methods in robotics and studies the properties of convergence of gradient slope algorithms and loss landscape in deep autoencoders neural networks. Additionally, he is interested in topological classifiers applied to defense against adversarial attacks. It is worth emphasizing the industrial research conducted in J. Cyranka's group on the application of computer vision and reinforcement learning to automatically analyze the games of professional teams in esports games in terms of team behavior.
The team led by T. Michalak focuses on the identification of groups of atypical trajectories (e.g. movement of objects). This is an extremely important problem, e.g. in the context of traffic management (e.g. Google Maps application), where groups of unusual traffic trajectories should be identified in real time, as they indicate the appearance of obstacles in communication. The obtained results show that the approach based on deep neural networks is more effective than data mining or standard ML algorithms.
Most important publications:
"Deep Learning Versus Traditional Solutions for Group Trajectory Outliers", IEEE Transactions on Cybernetics, 200 pkt. (Belhadi, Djenouri, Djenouri, T Michalak, JCW Lin)
"Machine Learning for Identifying Group Trajectory Outliers", ACM Transactions on Management Information Systems (TMIS), 12 (2), 1-25. (A Belhadi, Y Djenouri, D Djenouri, T Michalak, JCW Lin).
“ Online prediction via continuous artificial prediction markets” Jahedpari, F., Rahwan, T., Hashemi, S., Michalak, T. P., De Vos, M., Padget, J., & Woon, W. L. (2017).. IEEE Intelligent Systems, 32(1), 61-68.
“Model Based Reinforcement Learning for Atari”, Ł. Kaiser, M. Babaeizadeh, P. Miłos, B. Osiński, R. H. Campbell, K. Czechowski, D. Erhan, C. Finn, P. Kozakowski, S. Levine, A. Mohiuddin, R. Sepassi, G. Tucker, H. Michalewski, International Conference on Learning Representations, 2020

"Simulation-Based Reinforcement Learning for Real-World Autonomous Driving," B. Osiński *et al.*, *2020 IEEE International Conference on Robotics and Automation (ICRA), 2020, pp. 6411-6418, doi: 10.1109/ICRA40945.2020.9196730.*

2. A list of 5 research and development projects within national and international competitions in the area of artificial intelligence and implemented within the last 5 years prior to or in the year of the application (title, manager, source of financing, amount of financing) (max. 1 A4 page).

1. *TOTAL, Technology transfer between modern algorithmic paradigms,* prof. Ucz. dr hab. Marek Cygan, European Research Council ERC Starting Grant, 1 228 250 EUR
2. *Polish Returns PPN/PPO/2018/1/00029,* dr Jacek Cyranka, Polish National Agency for Academic Exchange NAWA, 1 630 000 PLN
3. *Machine Learning and automatic theorem proving, 2018/29/B/ST6/02959,* dr hab. Henryk Michalewski, National Science Centre Poland NCN, 867 000 PLN
4. *Reinforcement Learning – contemporary challenges, UMO-2017/26/E/ST6/00622,* dr Piotr Miłoś, National Science Centre Poland NCN, 1 746 300 PLN
5. *Multiwinner Election Rules: Beyond Scoring Protocols, UMO-2019/35/B/ST6/02215,* dr Piotr Skowron, National Science Centre Poland NCN,
   808 800 PLN

3. Available research equipment, apparatus/infrastructure and intangible assets held in the context of implementation of a project regarding artificial intelligence (max. 1 A4 page).

The computing infrastructure of the Faculty of Mathematics, Informatics and Mechanics of the University of Warsaw includes servers with sufficient power to allocate resources for all research groups created under the ARTIQ Center of Excellence program. We use funds from a number of projects implemented at the Faculty to renew and maintain the infrastructure.

As part of the cooperation between the Faculty of Mathematics, Informatics and Mechanics of the University of Warsaw and the Warsaw branch of Nvidia, our Faculty received 28 TITAN V cards. Cards donated by NVIDIA are available to students and researchers as part of the newly built cluster managed by M. Cygan and P. Miłoś.

Moreover, our computing resources include air-conditioned server rooms and computer laboratories with numerous PCs.

4. Facilities or incentives to establish an AI Centre of Excellence in the entity (max. 1 A4 page).

Last year, the University of Warsaw was awarded the status of a research university in the Initiative of Excellence Research University (IDUB) competition of the Ministry of Science and Higher Education. One of the priority research areas distinguished under the IDUB program and implemented mainly at the MIM faculty is entitled: The challenge of petabytes - advanced mathematics and computer science tools in big data analysis - from random processes on the stock exchange to medical diagnostics. This area is related to the acquisition and analysis of big data using advanced mathematical and computer science tools and forms a natural platform for cooperation with the ARTIQ Center.

Additional benefits for researchers of ARTIQ Centre include professional service supporting the research activity. The employees of the 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 resulting from the research activity of ARTIQ Centre.

Moreover, additional funding will be provided by the Dean of MIMUW to support small scientific meetings, workshops and individual research visits organized by ARTIQ Centre.

MIM UW department has an excellent pool of undergraduate and graduate students (each year 50-60 laureates of the Mathematics and Computer Science Olympiad choose to study here).

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

5. Other information concerning internationalisation of the entity, foreign scientists employed in this institution, availability of seminars in English, etc. (max. 1 A4 page).

Employees of the department are involved in top-level mathematical research, which by its very nature takes place in an international community. Mathematicians from MIMUW have hundreds of collaborators from around the world, 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).

Currently, over 10% of the Faculty's 243 research staff are foreigners (25 people). 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 MIMUW are also actively involved in the organization of international conferences. In recent years they have 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 funded grants.

Employees of MIMUW 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.

6. Other significant information confirming the experience and resources of the institution (max. 1 A4 page).

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.

We will achieve an additional synergy effect thanks to ambitious teaching plans at the Faculty of WMIM, where a new Machine Learning course will be launched from October 1, 2021.MSc studies (in English) in this field enable future graduates to acquire advanced knowledge and skills in techniques used in machine learning, including: statistical machine learning methods, deep neural networks, reinforcement learning and explaining the results obtained as a result of machine learning procedures. They also allow students to learn about the basic areas of machine learning applications, such as image recognition, control of autonomous devices or natural language processing. Thanks to this, graduates will be prepared to design, supervise and critically analyze IT projects with important components related to machine learning, to perform expert roles in machine learning and be leaders outside the university world. Clearly, students and graduates of this field of study will be natural candidates to become involved in ARTIQ's research initiatives.