



# MAP OF POLISH SCIENCE IN THE FIELD OF **AI**



NATIONAL  
INFORMATION  
PROCESSING  
INSTITUTE

digital**poland**

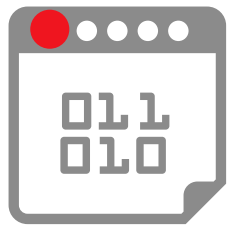
# EXECUTIVE SUMMARY

---

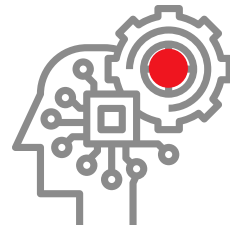
- **Publications:** In 2013-18, 6.5 thousand Polish researchers published 12 thousand scientific papers on AI. Computer scientists played a major role – 1.5 thousand of them published 5.3 thousand publications.
- **Institutions:** AGH in Kraków has the largest number of researchers who published articles on AI (524 people). As for faculties – the Faculty of Electronics and Information Technology, at the Warsaw University of Technology, is leading with 153 researchers.
- **Scientific societies:** In order to coordinate the effort, in 2018, five major societies have formed a new structure – Polish Initiative for the Advancement of Artificial Intelligence.
- **Regions:** Mazowieckie region has a strong lead in the number of AI researchers with 1 956 people publishing in the field. Two other regions with a considerable number of researchers are Małopolskie (969 people) and Śląskie (895 people).
- **PhD students:** Out of 43 thousand PhD students in Poland 2,6 thousand study mathematics-heavy disciplines with potential for AI. Five universities educate 46% of these PhD students.
- **New students:** Each year about 20 thousand students start their education in computer science.
- **Graduates:** Each year about 28 thousand technical sciences and 4 thousand mathematical sciences students graduate from Polish universities.

# ABOUT DIGITAL POLAND FOUNDATION

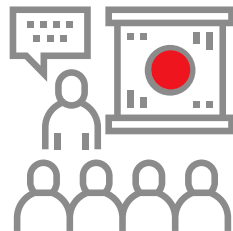
We want to make Poland one of the global digital innovation hubs. With our activities, we are turning digital challenges into opportunities for the Polish economy. We know that without well-educated society, Poland's digital transformation is not going to happen, so we educate and run a series of initiatives promoting digital technologies in Poland. This includes i.a. Digital Festival, Digital Shapers, Digital Summit, AI Academy, Digital Compass, our think tank and founders activities like Digital CEO, Fintech Gigabit & 5G Society. In all we do we underline the importance of collaboration in order to build a dynamic tech ecosystem in Poland.



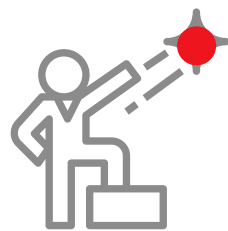
**Digital Festival**



**AI Academy**

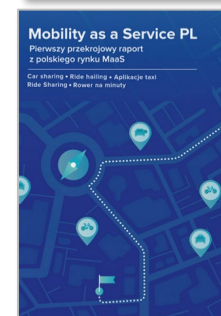
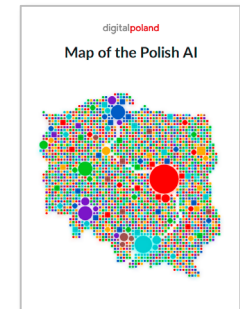
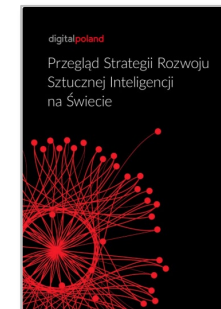


**Digital Summit**



**Digital Shapers**

## Examples of publications:



# ABOUT OPI PIB

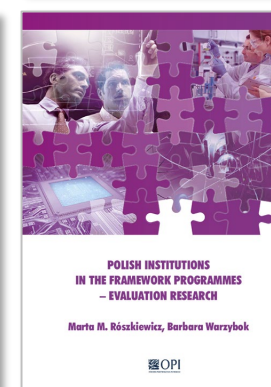
The National Information Processing Institute (OPI PIB) is active in the research and development sector. Our statutory objective is to provide easy access to up-to-date and comprehensive information about science and higher education in Poland. We realize that objective mostly by designing and building complex information systems for users from the science and higher education sector. In our systems we widely apply intelligent algorithms, machine learning, artificial intelligence and natural language processing tools.

We also manage a web portal about artificial intelligence, automatization and robotics: [www.sztucznainteligencja.org.pl](http://www.sztucznainteligencja.org.pl)

The web service is aimed at popularizing artificial intelligence among the general public – we publish articles about different aspects of AI, interviews with scientists, prognoses, and analyses of AI development in Poland and abroad.



Examples of publications:





**REPORT**

# AI RESEARCHERS AND SCIENTIFIC PUBLICATIONS

During the years 2013-18, there were 12 thousand publications covering research on AI and related topics\* registered in Polish Scientific Bibliography database. These publications were produced by 6.5 thousand researchers.

Computer scientists play a major role in the research. Nearly half of publications were produced by 1.5 thousand researchers from this domain of science.

## COMPUTER SCIENCE & TELECOMMUNICATION



### NUMBER OF RESEARCHERS

who during the years 2013-18  
published at least one research  
article on AI



### NUMBER OF PUBLICATIONS

covering keywords specific to  
AI\* published during the  
years 2013-18

## OTHER BRANCHES OF SCIENCE



### NUMBER OF RESEARCHERS

who during the years 2013-18  
published at least one research  
article on AI



### NUMBER OF PUBLICATIONS

covering keywords specific to  
AI\* published during the years  
2013-18

Source: analysis by OPI PIB based on PBN system, 07 May 2019.

\*Note: The analysis included scientific papers (articles, monographs, chapters in publications) published in 2013-18. Classification was done using keywords in both Polish and English.



# RANKING OF UNIVERSITIES BY NUMBER OF RESEARCHERS PUBLISHING IN BEST JOURNALS (1/2)\*

| Academic institution   | Voivodeship        | Number of<br>AI scientists from<br>all disciplines | Number of<br>AI scientist from<br>computer science | Number of AI<br>scientists<br>publishing in best<br>journals |
|--|--------------------|--|--|--|
| AGH University of Science and Technology                       | Małopolskie        | 523  | 147  | 106  |
| Warsaw University of Science and Technology                    | Mazowieckie        | 488  | 127  | 93   |
| Wrocław University of Science and Technology                   | Dolnośląskie       | 352  | 104  | 93   |
| University of Warsaw   | Mazowieckie        | 233  | 44   | 93   |
| Poznań University of Technology                                | Wielkopolskie      | 136  | 31   | 82   |
| Silesian University of Technology in Gliwice                   | Śląskie            | 441  | 95   | 74   |
| Gdańsk University of Technology                                | Pomorskie          | 256  | 67   | 48   |
| Jagiellonian University  | Małopolskie        | 118  | 33   | 43   |
| Technical University of Łódź                                   | Łódzkie            | 164  | 77   | 41   |
| University of Silesia  | Śląskie            | 100  | 41   | 35   |
| Białystok Technical University                                 | Podlaskie          | 48   | 30   | 27   |
| West Pomeranian University of Technology                       | Zachodniopomorskie | 138  | 47   | 26   |
| Częstochowa University of Technology                           | Śląskie            | 108  | 46   | 21   |
| Adam Mickiewicz University                                     | Wielkopolskie      | 80   | 13   | 21   |
| Tadeusz Kościuszko University of Technology                    | Małopolskie        | 83   | 20   | 19   |
| University of Zielona Góra                                     | Lubuskie           | 54   | 14   | 17   |
| Warsaw University of Life Sciences                             | Mazowieckie        | 61   | 21   | 15   |
| University of Łódź   | Łódzkie            | 93   | 18   | 14   |
| University of Information Technology and Management in Rzeszów | Podkarpackie       | 35   | 23   | 13   |
| Military University of Technology in Warsaw                    | Mazowieckie        | 200  | 51   | 13   |
| Poznań University of Economics                                 | Wielkopolskie      | 51   | 16   | 12   |
| University of Technology and Life Sciences in Bydgoszcz        | Kujawsko-pomorskie | 61   | 10   | 11   |
| University of Wrocław  | Dolnośląskie       | 42   | 9  | 11   |

\*According to the official list by the Ministry of Science and Higher Education.

# RANKING OF UNIVERSITIES BY NUMBER OF RESEARCHERS PUBLISHING IN BEST JOURNALS (2/2)\*

| Academic institution   | Voivodeship         | Number of AI scientists from all disciplines | Number of AI scientist from computer science | Number of AI scientists publishing in best journals |
|--|---------------------|--|--|---|
| University of Rzeszów  | Podkarpackie        | 51   | 22   | 10  |
| Koszalin University of Technology                                  | Zachodniopomorskie  | 75   | 14   | 9   |
| Rzeszów University of Technology                                   | Podkarpackie        | 64   | 17   | 9   |
| Maria Curie-Skłodowska University                                  | Lubelskie           | 26   | 8  | 9   |
| Nicolaus Copernicus University                                     | Kujawsko-pomorskie  | 69   | 11   | 9   |
| Opole University of Technology                                     | Opolskie            | 84   | 24   | 8   |
| University of Warmia and Mazury                                    | Warmińsko-mazurskie | 59   | 7  | 8   |
| Polish-Japanese Academy of Information Technology                  | Mazowieckie         | 46   | 19   | 8   |
| Gdynia Maritime University   | Pomorskie           | 49   | 8  | 7   |
| John Paul II Catholic University                                   | Lubelskie           | 27   | 15   | 7   |
| Casimir the Great University                                       | Kujawsko-pomorskie  | 20   | 10   | 6   |
| University of Białystok  | Podlaskie           | 40   | 18   | 5   |
| University of Bielsko-Biała  | Śląskie             | 54   | 15   | 4   |
| Kielce University of Technology                                    | Świętokrzyskie      | 70   | 21   | 4   |
| University of Social Sciences in Łódź                              | Łódzkie             | 9  | 6  | 3   |
| University of Economics in Katowice                                | Śląskie             | 58   | 10   | 3   |
| Cardinal Stefan Wyszyński University                               | Mazowieckie         | 37   | 9  | 3   |
| University of Natural Sciences and Humanities in Siedlce           | Mazowieckie         | 16   | 11   | 3   |
| Lublin University of Technology                                    | Lubelskie           | 114  | 15   | 2   |
| Opole University   | Opolskie            | 27   | 11   | 2   |
| Maritime University of Szczecin                                    | Zachodniopomorskie  | 48   | 24   | 2   |
| Warsaw school of Information Technology                            | Mazowieckie         | 8  | 8  | 2   |
| Kazimierz Pułaski University of Technology and Humanities in Radom | Mazowieckie         | 51   | 8  | 1   |

\*According to the official list by the Ministry of Science and Higher Education.



# RANKING OF PUBLIC RESEARCH INSTITUTES BY NUMBER OF RESEARCHERS PUBLISHING IN BEST JOURNALS

| Academic institution  | Voivodeship   | Number of AI scientists from all disciplines | Number of AI scientist from computer science | Number of AI scientists publishing in best journals |
|---|---------------|--|--|---|
| Systems Research Institute (Polish Academy of Sciences)                       | Mazowieckie   | 66   | 51   | 27  |
| Institute of Computer Science (Polish Academy of Sciences)                    | Mazowieckie   | 45   | 36   | 21  |
| Institute of Fundamental Technological Research (Polish Academy of Sciences)  | Mazowieckie   | 29   | 12   | 11  |
| National Institute of Telecommunications                                      | Mazowieckie   | 24   | 20   | 10  |
| Institute of Innovative Technologies EMAG (Łukasiewicz Research Network)      | Śląskie       | 18   | 13   | 9   |
| National Information Processing Institute (OPI PIB)                           | Mazowieckie   | 23   | 15   | 8   |
| Institute of Theoretical and Applied Informatics (Polish Academy of Sciences) | Śląskie       | 16   | 13   | 6   |
| Institute of Bioorganic Chemistry (Polish Academy of Sciences)                | Wielkopolskie | 50   | 27   | 5   |
| NASK Research and Academic Computer Network                                   | Mazowieckie   | 12   | 9  | 2   |
| Air Force Institute of Technology   | Mazowieckie   | 31   | 6  |   |
| Foundry Research Institute (Łukasiewicz Research Network)                     | Małopolskie   | 16   | 6  |   |

\*According to the official list by the Ministry of Science and Higher Education.

# SCIENTIFIC SOCIETIES

There are a number of scientific societies in Poland which focus their attention on data science, artificial intelligence and machine learning. Some have already been operating for certain time. For example, **Polish Neural Network Society** was founded in 1995.

In order to coordinate the effort of developing the AI sector, five major societies have formed a new structure – **Polish Initiative for the Advancement of Artificial Intelligence**.

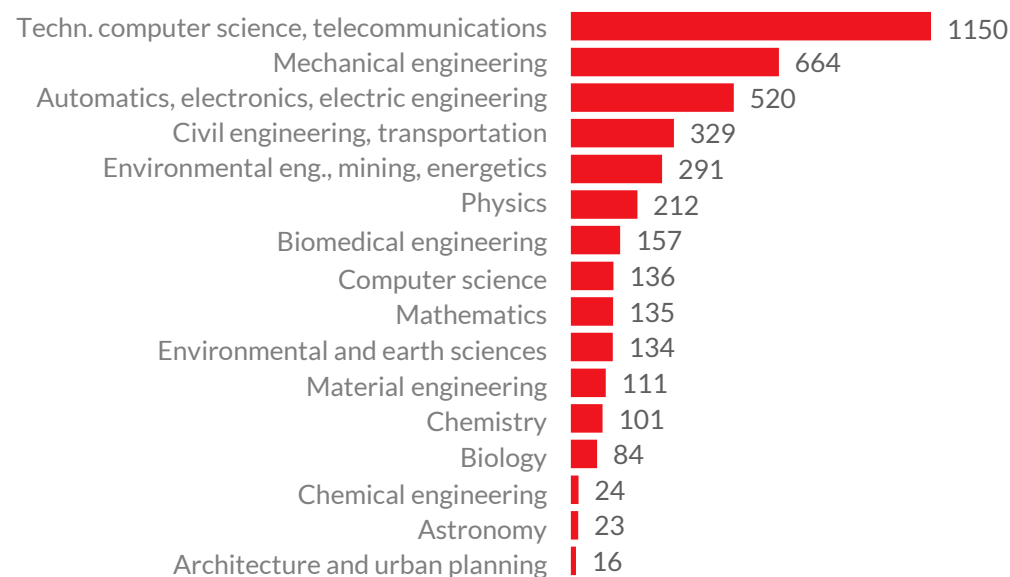
| Organisation   | Foundation | President   |
|--|------------|---|
| Polish Initiative for the Advancement of Artificial Intelligence<br>(PP-RAI: Polskie Porozumienie na Rzecz Rozwoju Sztucznej Inteligencji) | 2018       | Coordination committee consists of 9 members who represent each of 5 founding societies   |
| 5 PP-RAI societies:  |            |   |
| Polish Artificial Intelligence Society (Polskie Stowarzyszenie Sztucznej Inteligencji)   | 2009       | Grzegorz J. Nalepa, AGH University of Science and Technology  |
| Polish Neural Network Society (Polskie Towarzystwo Sieci Neuronowych)  | 1995       | Leszek Rutkowski, Częstochowa University of Technology  |
| Polish Special Interest Group on Machine Learning<br>(Polska Grupa Systemów Uczących się PL SIGML)   | 2013       | Jacek Koronacki, Polish Academy of Sciences;<br>Jerzy Stefanowski, Poznań University of Technology;<br>Michał Woźniak, Wrocław University of Science and Technology |
| Polish Chapter of the IEEE Systems, Man, and Cybernetics Society   |            | Piotr Jędrzejowicz, Gdynia Maritime University  |
| Poland Section of IEEE Computational Intelligence Society  |            | Joanna Kołodziej, Warsaw University of Technology   |
| Other societies:   |            |   |
| IEEE Robotics and Automation Society Polish Section  |            | Krzysztof Kozłowski, Poznań University of Technology  |
| Association for Image Processing (Polish Member Society of the IAPR logo<br>International Association for Pattern Recognition)             | 1998       | Leszek Chmielewski, Warsaw University of Life Sciences  |
| Network Science Society (Polish Chapter)   |            | Przemysław Kazienko, Wrocław University of Technology   |
| Poland Chapter of IEEE Signal Processing Society   |            | Piotr Samczyński, Warsaw University of Technology   |
| International Neuroinformatics Coordinating Facility Node of Poland  | 2007       | Tomasz Piotrowski, Nicolaus Copernicus University   |

# SCIENTIFIC PUBLICATIONS (1/4)

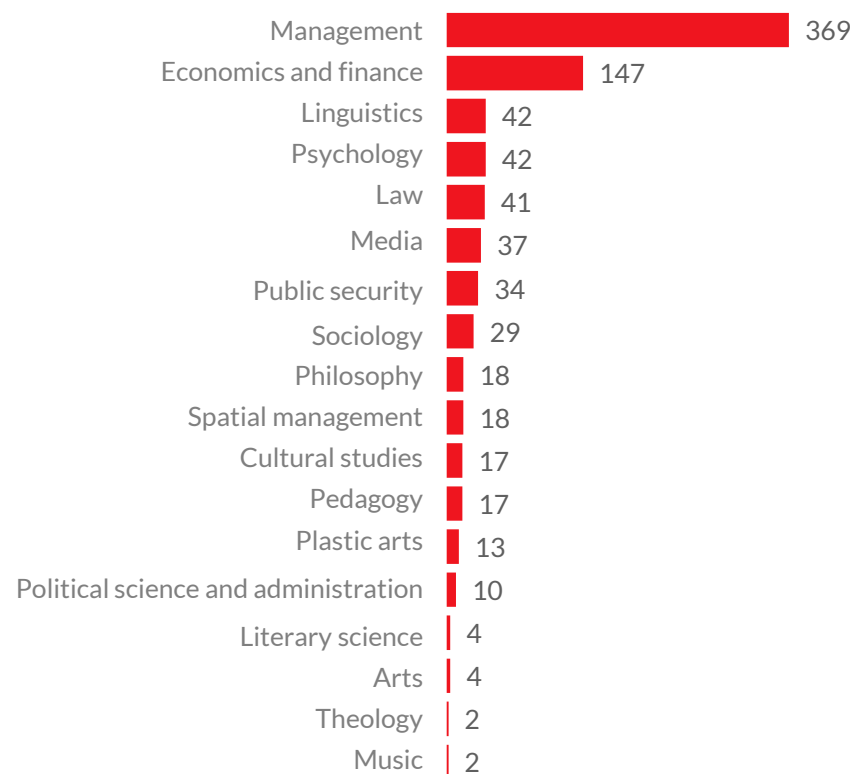
Most of research papers on AI\* are written by people from STEM fields. However, it must be noted that many economists and management scientists also publish articles on AI. Finally, several researchers working in the field of medicine and agriculture conduct research on AI.

## Number of scientists publishing in the field of AI

### STEM sciences



### Humanities, social sciences and arts



\*Note: The analysis included scientific papers (articles, monographs, chapters in publications) published in 2013-18. Classification was done using keywords in both Polish and English.

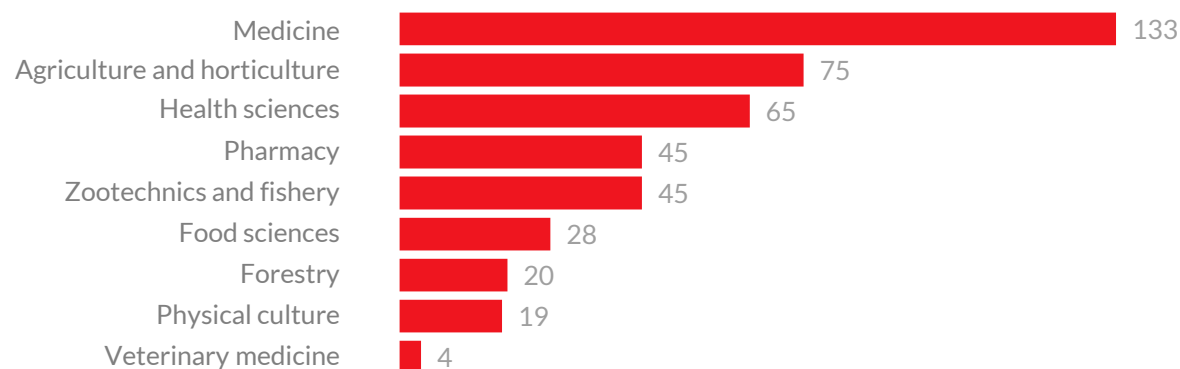
Source: analysis by OPI PIB based on PBN system, 07 May 2019.

# SCIENTIFIC PUBLICATIONS (2/4)

---

## Number of scientists publishing in the field of AI

### Life sciences, medicine and health



\*Note: The analysis included scientific papers (articles, monographs, chapters in publications) published in 2013-18.  
Classification was done using keywords in both Polish and English.

Source: analysis by OPI PIB based on PBN system, 07 May 2019.

# SCIENTIFIC PUBLICATIONS (3/4)

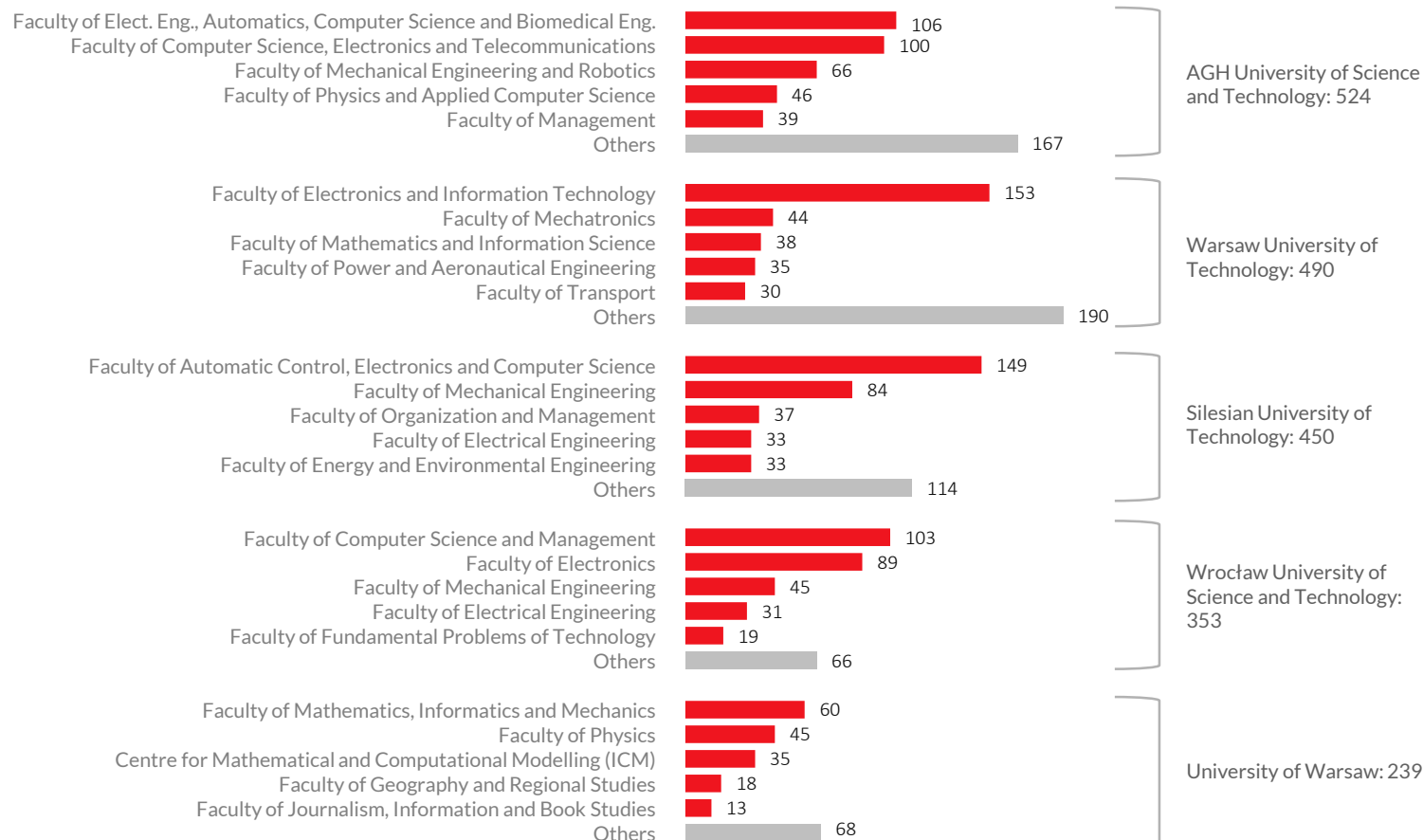
## Universities with the biggest number of researchers publishing in the field of AI

AGH in Kraków has the largest number of researchers who published articles on AI\* (524 people). Warsaw University of Technology comes second with 490 researchers.

Usually, researchers work in faculties such as Computer Science, Electronics, Electrical Engineering or Mechatronics.

Two faculties that employ the largest number of AI researchers are:

- Faculty of Electronics and Information Technology, Warsaw University of Technology (153 people)
- Faculty of Automatic Control, Electronics and Computer Science, Silesian University of Technology (149 people)



\*Note: The analysis included scientific papers (articles, monographs, chapters in publications) published in 2013-18. Classification was done using keywords in both Polish and English.

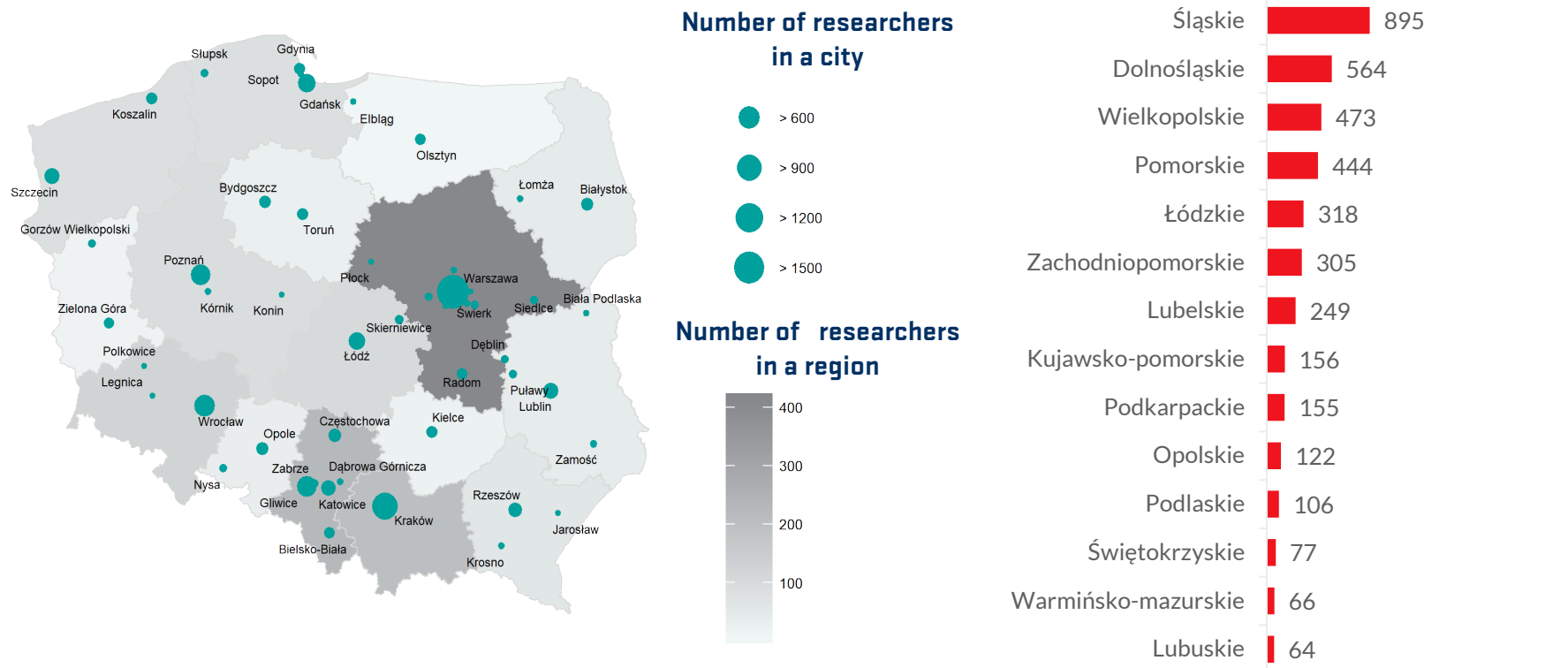
Source: analysis by OPI PIB based on PBN system, 07 May 2019.

# SCIENTIFIC PUBLICATIONS (4/4)

## Regions and agglomerations with the biggest number of researchers publishing in the field of AI

Mazowieckie region has a strong lead in the number of AI researchers with 1 956 people publishing in the field\*.

Two other regions with a considerable number of researchers are Małopolskie (969 people) and Śląskie (895 people).



\*Note: The analysis included scientific papers (articles, monographs, chapters in publications) published in 2013-18. Classification was done using keywords in both Polish and English.

Source: analysis by OPI PIB based on PBN system, 07 May 2019.



# OUTPUT OF PhDs

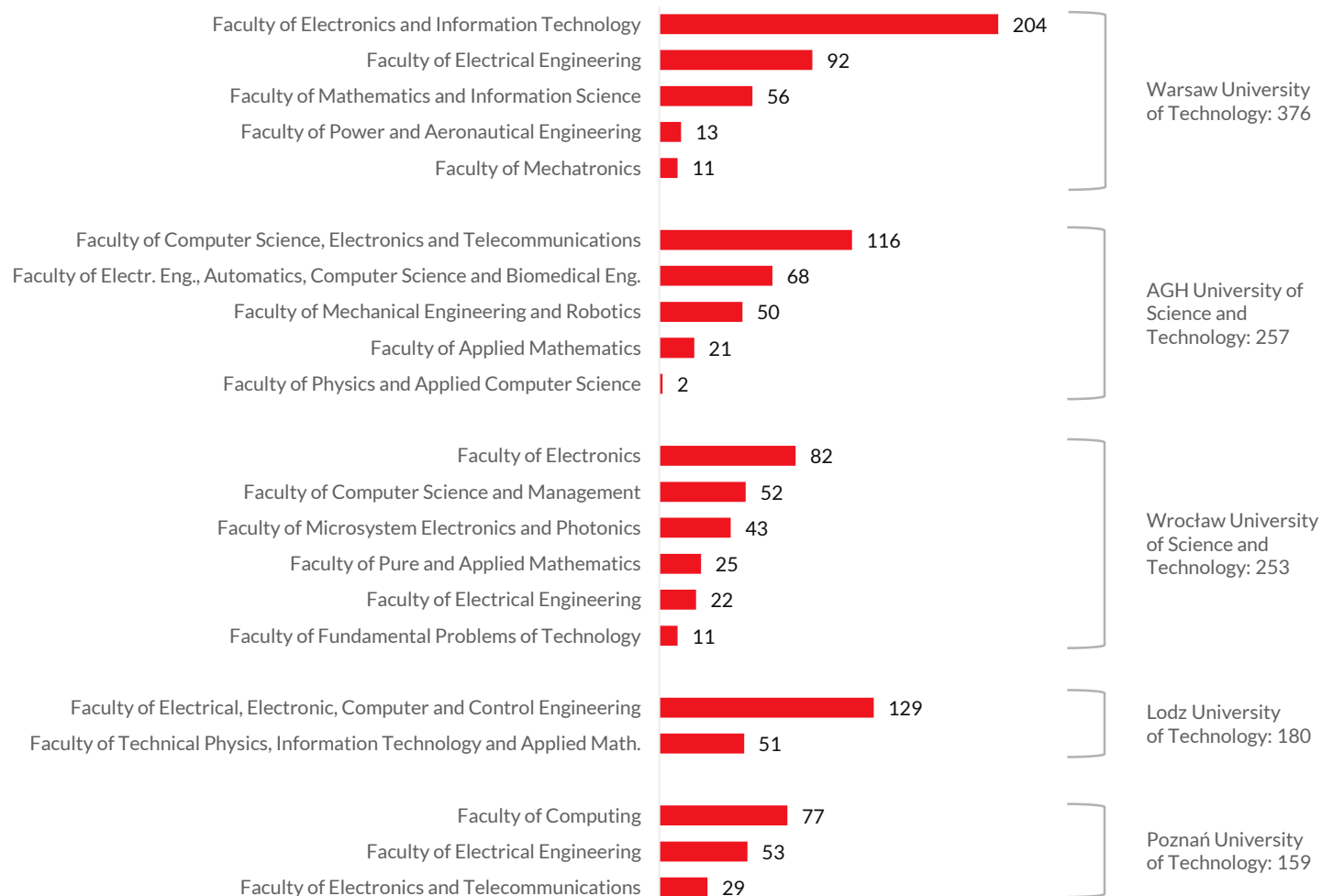
## Universities with the biggest number of PhD students in areas with AI potential

In the years 2014-17 there were on average thousand PhD students in Poland 2,6 thousand study in areas with potential for AI, defined as belonging to:

- Mathematics
- Physics
- Computer science
- Robotics
- Automatics
- Electrical engineering
- Electronics
- Telecommunications

Five universities educate 46% of all PhD students in the areas with AI potential.

Each of these top universities operates in a different agglomeration which effects in a better access to AI education and expertise across the country.

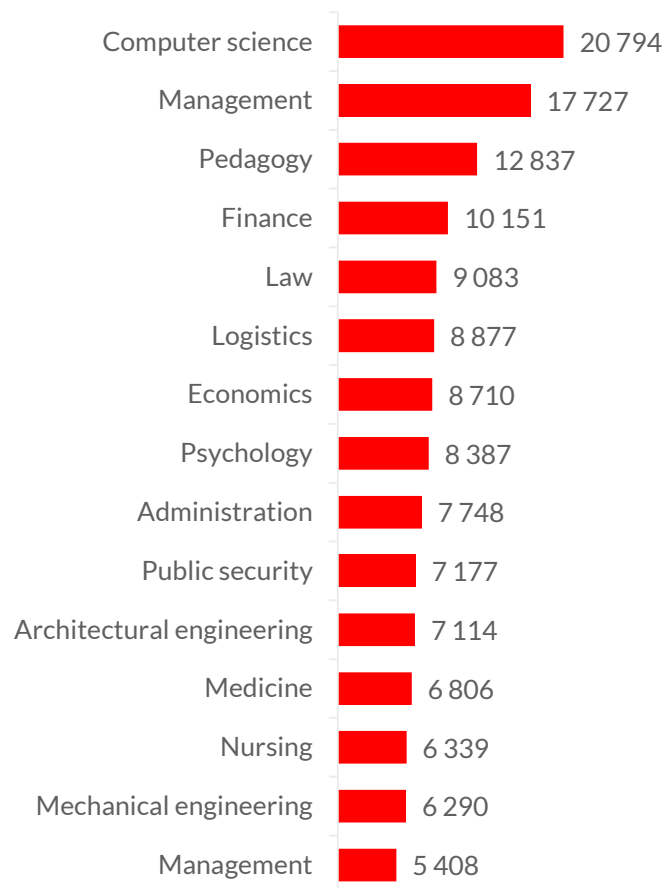


# STUDENTS AND GRADUATES (1/3)

In 2016, about 160 thousand students graduated from Polish universities. Among them 28 thousand studied technical sciences and 4 thousand mathematical sciences.

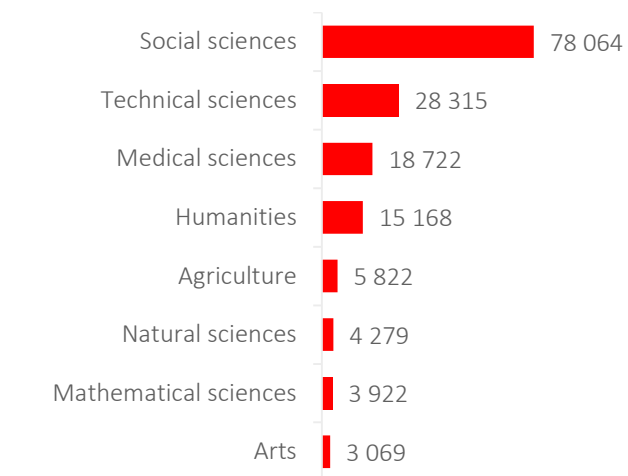
For the semester 2017/18, there were over 20 thousand new students of computer science.

**New students in academic year 2017/18  
(top 15 categories)**



Source: analysis by OPI PIB based on POL-on system,  
18 March 2018

**Graduates in 2016**



**Out of these 7,5 thousand (4,6%)  
come from programmes with AI  
potential**

Source: analysis by OPI PIB based on ELA – Polish Graduate  
Tracking System, 30 September 2017

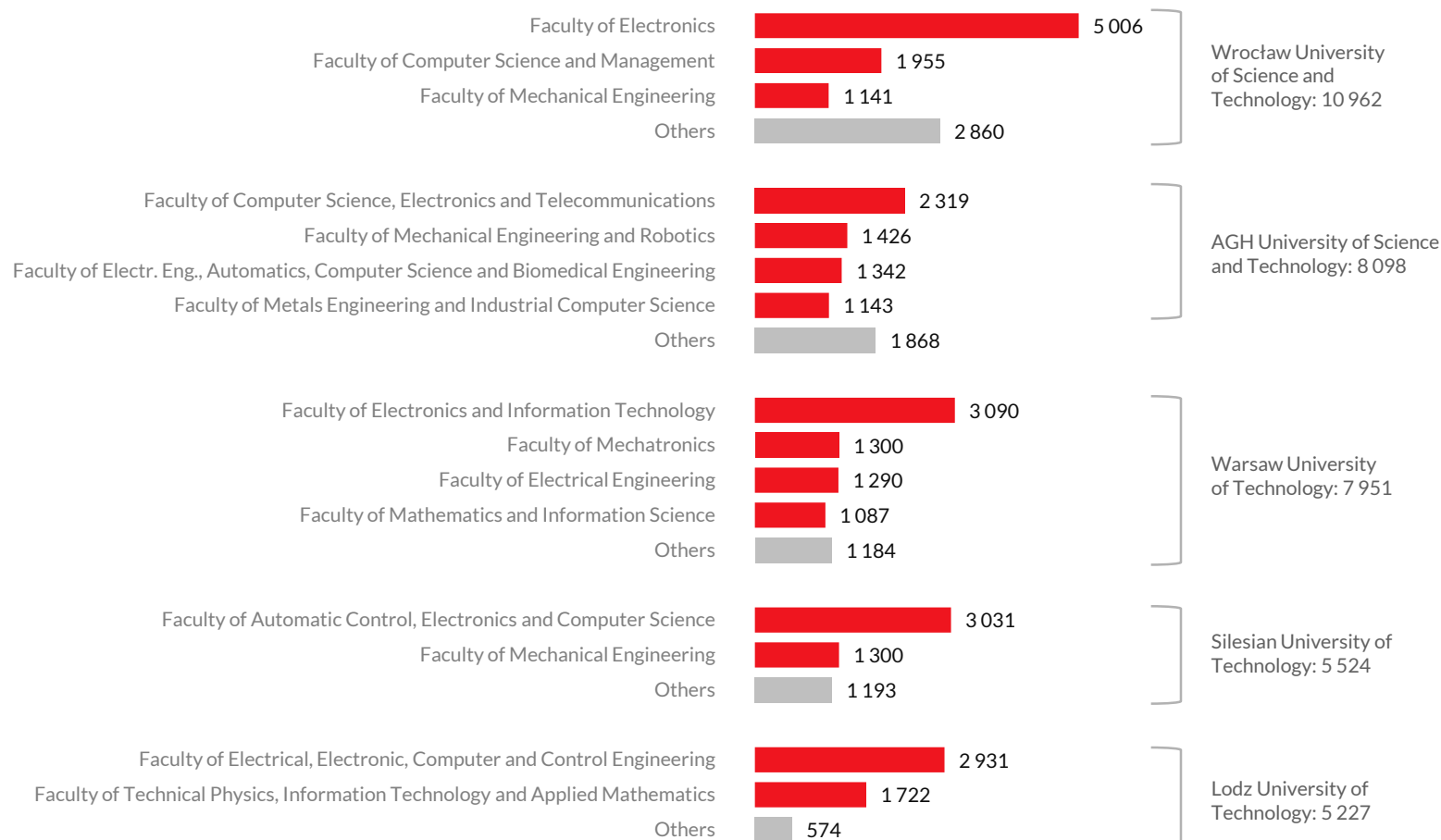
\*Note: The data on new entrants and graduates come from different systems, use different categories and are not fully comparable.

# STUDENTS AND GRADUATES (2/3)

## Universities with the biggest number of students in areas with AI potential\* in 2017

As of 2017, there were about **120 thousand students** studying in fields with AI potential.

The largest number of such students (nearly 11 thousand) were educated in the Wrocław University of Science and Technology, with 5 thousand studying in the faculty of Electronics.



\*Note: Areas with AI potential are defined as belonging to: mathematics, physics, computer science, robotics, automatics, electrical engineering, electronics, telecommunications

Source: analysis by OPI PIB based on POL-on system, 18 March 2018

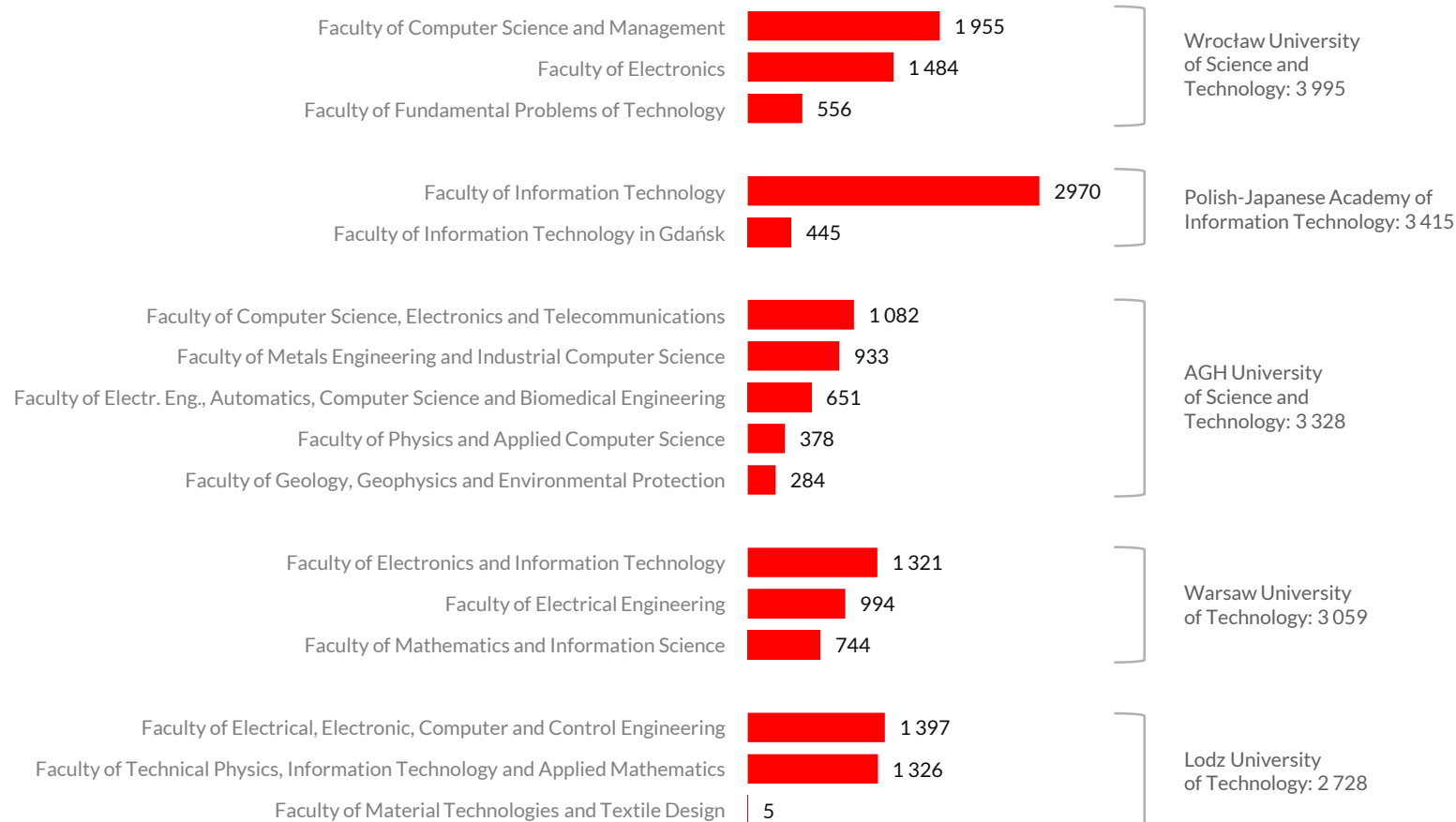
# STUDENTS AND GRADUATES (3/3)

## Universities with the biggest number of students in areas with AI potential\* in 2017

There were about **70 thousand students pursuing their education in computer science.**

Wrocław University of Science and Technology educated the highest number of them. Its three faculties had 4 thousand computer science students.

Importantly, **Polish-Japanese Academy of Information Technology came second with 3.4 thousand students.** This institution may not be leading in research, however it clearly plays a very significant educational role.



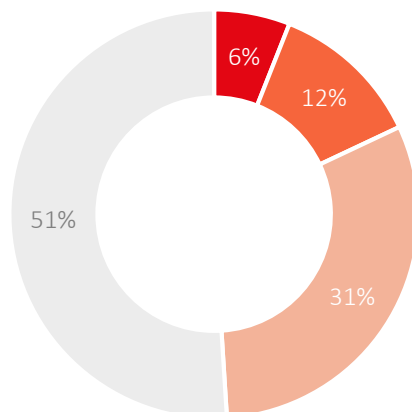
# COOPERATION WITH PRIVATE SECTOR

There are over 200 companies dealing with AI in Poland.

These companies cooperate heavily with the scientific community. Actually, half them hire at least one PhD.

Additionally, there are over 40 companies that invested in R&D centres developing AI, big data and software products in Poland.

Number of PhDs in the AI team



- 6 or more people
- 3-5 people
- 1-2 people
- No one

Sample of startups



Industrial machine vision



AI implementation



AdTech



AI implementation



FinTech



Sales automation



Remote health diagnostics (ECG)



Anti-fraud technology



Robotics



Retargeting technology



Omnichannel marketing



Natural language processing

Sample of R&D centres



The text-to-speech technology powering Alexa is developed in Gdańsk



In Gdańsk, Intel runs the largest R&D centre in Europe, specializing in computation technology



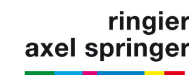
In Łódź and Poznań, TomTom develops autonomous vehicle technology



In Kraków and Łódź, the company runs the largest R&D operations outside of Sweden



DT R&D centre in Warsaw is focused on AI for all NatCos



RAS is building an AI centre of excellence for the media sector



In Warsaw, Samsung runs the largest R&D centre outside of Korea and develops NLP



NVIDIA

In Warsaw, Nvidia optimizes deep learning platforms across the software stack



In Kraków, UBS runs its R&D centre, developing AI and machine learning



In Kraków, Aptiv develops autonomous vehicle technology



digitalpoland

# SCIENTIFIC AND PROFESSIONAL CONFERENCES

---

## ICAISC

### ICAISC

The International Conference on Artificial Intelligence and Soft Computing is focused on various aspects of artificial intelligence and machine learning. It is held annually for five days in Zakopane.



### TFML

The Theoretical Foundations of Machine Learning Conference is organized by The Department of Machine Learning, Institute of Computer Science and Computational Mathematics, Faculty of Mathematics and Computer Science, Jagiellonian University.



### PI in ML

Conference for young researchers focused on research and applications of deep learning. Held annually for four days. Aimed at researchers.



### PyData

The largest data science conference focused on users of Python language. Held annually for two days. Aimed at specialists.



### Why R?

Conference focused on applications of R language. Held annually for two days. Aimed at specialists.



### Data Science Summit

Conference on various data science topics, including machine learning, big data and data visualisation. Held annually, lasts one day. Aimed at specialists and students.

There are many conferences covering topics such as artificial intelligence, machine learning, data science and big data. They differ regarding the profile of target audience (specialists vs. non-experts), the stage of career (students vs. professionals), and the topic of the conference (research vs. business applications).

Most of major conferences are organised in Warsaw.





# **APPENDIX: SELECTED AI CENTRES BY SPECIALIZATION**

# APPENDIX: SELECTED AI CENTRES BY SPECIALIZATION

| Specialization | Institution  | Faculty, institute, department or laboratory   | Specialization details   |
|----------------|--|--|--|
| Data science   | Institute of Computer Science Polish Academy of Sciences | Department of Artificial Intelligence  | Exploration of large graph models for Internet networks and searching for information in large text repositories.  |
|                | Poznań University of Technology                          | Faculty of Computing (Institute of Computing Science, Laboratory of Computing Systems) | Algorithms to construct classifier groups  |
|                | Wrocław University of Science and Technology             | Faculty of Computer Science and Management (Department of Computational Intelligence)  | Analysis of social phenomena, social media, scientometry, learning science, processing and analysis of social networks and complex networks, analysis of natural language texts, prevention algorithms, methods for data science, machine learning, analysis of network data structure with the use of deep machine learning |
|                | University of Warsaw                                     | Faculty of Mathematics, Informatics and Mechanics (Institute of Informatics)           | Development of tools supporting the implementation of AI mechanisms in video games   |

Source: OPI PIB study based on expert opinions prepared by: prof. W. Duch, prof. K. Jassem, prof. P. Kazienko, prof. J. Koronacki, prof. K. Krawiec, prof. H. Kwaśnicka, prof. J. Mańdziuk, prof. G.J. Nalepa, prof. M. Piasecki, dr A. Przeglasińska, prof. L. Rutkowski, prof. J. Stefanowski.

# APPENDIX: SELECTED AI CENTRES BY SPECIALIZATION

| Specialization  | Institution  | Faculty, institute, department or laboratory   | Specialization details   |
|-----------------|--|--|--|
| Neural networks | AGH University of Science and Technology                       | Faculty of Electrical Engineering, Automatics Computer Science and Biomedical Engineering (Department of Biocybernetics and Biomedical Engineering and Department of Automatic Control and Robotics) | Neural networks applied in image recognition, uncovering the knowledge on image recognition, particularly in the medical application context (SPECT imaging, roentgen imaging)   |
|                 | Systems Research Institute Polish Academy of Sciences          | Department of Intelligent Systems  | New SSN architecture, using the alternative learning algorithms, e.g. particle swarm algorithms, application in face recognition   |
|                 | Częstochowa University of Technology                           | Faculty of Mechanical Engineering and Computer Science (Institute of Intelligent Information Systems)  | New SSN architecture, including probabilistic and fuzzy networks, neural-fuzzy systems, complex classifiers  |
|                 | Poznań University of Technology                                | Faculty of Computing (Institute of Computing Science, Laboratory of Intelligent Decision Support Systems)  | Artificial neural networks in pathomorphological diagnostics, deep artificial neural networks for the segmentation of ophthalmologic imaging and the detection of anomalies in computer lung tomography  |
|                 | Warsaw University of Technology                                | Faculty of Mathematics and Information Science (Division of Artificial Intelligence and Computational Methods)   | Intelligent computation methods, artificial neural networks, learning algorithms, machine learning   |
|                 | University of Social Sciences                                  | Faculty of Humanities (Department of Computer Science, Warsaw branch)  | Alternative architecture, models and algorithms of artificial neural network learning, extraction of traits, in particular the not supervised extraction of traits, unsupervised learning of artificial neural networks, autoencoder architecture in particular.                   |
|                 | University of Zielona Góra                                     | Faculty of Computer, Electrical and Control Engineering (Institute of Control and IT Systems)  | Artificial neural networks: structure optimization, self-organizing networks of the GDMH type, dynamic networks, multi-network structures, learning algorithms; fuzzy systems and neural-fuzzy systems: optimization of parameters and the structure, gradient learning algorithms |
|                 | University of Information Technology and Management in Rzeszów | Applied Computer Science Faculty (Department of Applied Information Systems)   | New neural network architecture, with particular focus on memory.  |

# APPENDIX: SELECTED AI CENTRES BY SPECIALIZATION

| Specialization   | Institution   | Faculty, institute, department or laboratory  | Specialization details   |
|------------------|---|---|--|
| Image processing | AGH University of Science and Technology                                      | Faculty of Computer Science, Electronics and Telecommunications (Department of Electrical Engineering)      | Recognizing the weariness of drivers, recognition of road signs with the use of artificial neural networks, adaptive segmentation of colour paintings with the use of machine learning, learning and usage of complex classifiers from the image recognition                                     |
|                  | AGH University of Science and Technology                                      | Faculty of Management (Department of Applied Computer Science)  | Biometric systems, interpretation of medical imaging, cognitive computational intelligence in medical pattern semantic understanding   |
|                  | Systems Research Institute<br>Polish Academy of Sciences                      | Department of Intelligent Systems   | Application of fuzzy systems and granular calculations in the image analysis and interpretation, new architecture of artificial neural networks, application of alternative learning algorithms, e.g. swarm particle algorithms, used in facial recognition                                      |
|                  | Institute of Fundamental Technological Research<br>Polish Academy of Sciences | Department of Information and Computational Science   | Analysis of medical imaging with the use of, among others, evolutionary algorithms   |
|                  | Częstochowa University of Technology  | Faculty of Mechanical Engineering and Computer Science (Institute of Intelligent Information Systems)       | Handwriting analysis, particularly in the application of identification, image segmenting, stereovision  |
|                  | Łódź University of Technology   | Faculty of Electrical, Electronic, Computer and Control Engineering (Institute of Applied Computer Science) | Tissue segmentation in microscopic imaging, segmentation of blood vessels in computer tomography imaging, usage of deep artificial neural networks in trees' age estimation on the basis of tree-ring analysis, MRI imaging analysis in the oncological diagnostics and other medical conditions |

# APPENDIX: SELECTED AI CENTRES BY SPECIALIZATION

| Specialization   | Institution                                  | Faculty, institute, department or laboratory   | Specialization details   |
|------------------|--|--|--|
| Image processing | Poznań University of Technology              | Faculty of Computing (Institute of Computing Science, Laboratory of Intelligent Decision Support Systems)                                | Evolutionary algorithms in the learning of image analysis programs, with the application in medical diagnosis, detecting registration plates, generic object recognition, and recognizing objects in imaging outside of visible light, artificial neural networks in patomorphological diagnostic, deep artificial neural networks for opthalmologic image segmentation and anomaly detection in computer tomography of lungs. |
|                  | Poznań University of Technology              | Faculty of Electrical Engineering (Institute of Control and Information Engineering, Laboratory of Automation and Robotics)              | Detectors and trait descriptors in robotics, particularly in navigation, face and eye recognition with the application of the machine learning methods, expedient device implementation, new architecture of artificial neural networks.   |
|                  | Silesian University of Technology            | Faculty of Automatic Control, Electronics and Computer Science (Institute of Automatic Control, Division of Explorational Data Analysis) | Adaptive median filtering, background noise reduction, segmentation of structure images of the central nervous system, ultrasound image analysis, recognizing emotions on the basis of face image  |
|                  | Warsaw University of Technology              | Faculty of Electrical Engineering (Division of Theory of Electrical Engineering and Applied Informatics)                                 | Analysis of shape, Fourier descriptors and wavelet descriptors, artificial neural networks   |
|                  | Wrocław University of Science and Technology | Faculty of Electronics (Department of Systems and Computer Networks)   | Analysis of texture with the application of machine learning techniques, with the application in medical diagnostics, basic research in the area of machine learning, in particular complex classifiers  |
|                  | Warsaw University of Life Sciences - SGGW    | Faculty of Applied Informatics and Mathematics (Department of Image Processing and Object Recognition)                                   | Conventional techniques of image analysis, with application in object detection, 3D image analysis   |
|                  | University of Zielona Góra                   | Faculty of Computer, Electrical and Control Engineering (Institute of Control and IT Systems)  | Segmentation of patomorphological images in breast cancer diagnosis and the application of machine learning methods in this area, cytological image analysis (patomorphology)  |

# SELECTED AI CENTRES BY SPECIALIZATION

| Specialization                  | Institution  | Faculty, institute, department or laboratory   | Specialization details  |
|---------------------------------|--|--|---|
| Evolutionary algorithms         | Institute of Fundamental Technological Research Polish Academy of Sciences | Department of Information and Computational Science  | Analysis of medical imaging, inter alia, with the application of evolutionary algorithms  |
|                                 | Poznań University of Technology  | Faculty of Computing (Institute of Computing Science, Laboratory of Intelligent Decision Support Systems)      | Teaching the game strategy with the application of evolutionary algorithms, augmented learning and neural networks and hybridization of these approaches, evolutionary algorithms in learning the image analysis programs, with application in medical diagnosis, detecting registration plates, generic object recognition, and recognizing objects in imaging beyond the visible light  |
|                                 | Silesian University of Technology  | Faculty of Automatic Control, Electronics and Computer Science (Institute of Informatics, Team of Programming) | Hybridization of machine learning methods with evolutionary algorithms, the application in detection algorithms and skin segmentation, facial recognition, hand recognition, gesture recognition, sign language, using the swarm algorithms to tune hyperparameters of deep artificial neural networks  |
| Fuzzy sets and approximate sets | Systems Research Institute Polish Academy of Sciences                      | Department of Intelligent Systems  | Fuzzy logic, application of fuzzy logic in databases, decision support systems, fuzzy methods of information representation and processing, controlling and making decisions in uncertain conditions and a lack of precision, evolutionary programming, neural networks, new architecture of artificial neural networks, application of alternative learning algorithms, e.g. particle swarm algorithms, with the application in facial recognition |
|                                 | Poznań University of Technology  | Faculty of Computing (Institute of Computing Science, Laboratory of Intelligent Decision Support Systems)      | Intelligent decision support systems making decisions, among others, on the basis of knowledge uncovered from incomplete data with the use of the dominant theory of rough sets   |



# APPENDIX: SELECTED AI CENTRES BY SPECIALIZATION

| Specialization | Institution  | Faculty, institute, department or laboratory   | Specialization details   |
|----------------|--|--|--|
| Expert systems | Poznań University of Technology                                | Faculty of Computing<br>Institute of Computing Science<br>(Laboratory of Intelligent Decision Support Systems)                       | Intelligent decision support systems making decisions, among others, based on the knowledge uncovered from incomplete data with the usage of the dominant theory of rough sets                   |
|                | University of Zielona Góra                                     | Faculty of Computer , Electrical and Control Engineering<br>(Insitute of Control and IT Systems)                                     | Expert systems: integrated knowledge base, knowledge representation (rule-based, procedural, neural), acquiring knowledge.   |
|                | University of Information Technology and Management in Rzeszów | Applied Computer Science Faculty<br>(Department of Applied Information Systems)  | Agent systems  |
| Robotics       | Łódź University of Technology                                  | Faculty of Electrical, Electronic, Computer and Control Engineering<br>(Institute of Electronics, Department of Medical Electronics) | Human-computer interfaces used by the disabled, quality control and processing of biomedical signals   |
|                | Poznań University of Technology                                | Faculty of Electrical Engineering<br>(Institute of Control, Robotics and Information Engineering)                                    | Detectors and descriptors of traits in robotics, particularly in navigation, facial recognition and eye recognition with the application of machine learning methods, fast device implementation |
|                | Nicolaus Copernicus University in Toruń                        | Centre for Modern Interdisciplinary Technologies<br>(Neurocognitive Laboratory)  | Machine learning, cognitive computer science, nurocognitive technologies   |
|                | University of Information Technology and Management in Rzeszów | Applied Computer Science Faculty<br>(Department of Applied Information Systems)  | Robot navigation application   |

# APPENDIX: SELECTED AI CENTRES BY SPECIALIZATION

| Specialization              | Institution  | Faculty, institute, department or laboratory  | Specialization details   |
|-----------------------------|--|---|--|
| Natural language processing | AGH University of Science and Technology                 | Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering (Department of Computer Science) | Natural language analysis, dialogue systems, voice recognition systems, building of ontology linked with lexical resources, extracting semantic relations from texts, semantic classification of texts, Polish language tagers using the deep LSTM networks  |
|                             | Institute of Polish Language Polish Academy of Sciences  |   | The Institute is not a computer science institution, but many resources in Polish and Latin were compiled at the Institute, based on proprietary language material (historical dictionaries, contemporary, proper names). The Institute conducts research on stylometric methods and the application of statistical method in literature analysis. |
|                             | Institute of Computer Science Polish Academy of Sciences | Department of Artificial Intelligence (Linguistic Engineering Group)  | Open language technology for the Polish language; natural language analysis, information extraction methods.   |
|                             | Institute of Slavic Studies Polish Academy of Sciences   | Department of Linguistics   | The Institute is not a computer science institution, but it has designed several bilingual corpora, comparing Polish and Bulgarian, Lithuanian, Russian and Ukrainian  |
|                             | National Information Processing Institute                | Natural Language Processing Laboratory  | Extracting information from texts, detecting plagiarism, the application of natural language engineering in recommendation engines, identifying key words, polarization analysis, emotional connotations   |
|                             | Polish-Japanese Academy of Information Technology        | Multimedia Department   | Speech recognition for the Polish language, algorithms for gathering comparative corpora from Internet sources, automatic translation systems, improvement of translation quality used by the „Marian” system by the application of proprietary programmes.  |

# APPENDIX: SELECTED AI CENTRES BY SPECIALIZATION

| Specialization              | Institution                                 | Faculty, institute, department or laboratory   | Specialization details  |
|-----------------------------|---|--|---|
| Natural language processing | Gdańsk University of Technology             | Faculty of Electronics, Telecommunications and Informatics (Department of Intelligent Interactive Systems)     | Natural language analysis, designing the dictionary structures in the form of finite state machines, arborescent automated machines, research on the application of language technology for the English language, information searching, methods of semantic assessment of text similarity  |
|                             | Silesian University of Technology           | Faculty of Automatic Control, Electronics and Computer Science (Institute of Informatics, Team of Programming) | A complex system for the Polish language to sign language translation, the application of semantic language resources   |
|                             | Warsaw University of Technology             | Faculty of Electronics and Information Technology (Institute of Computer Science)                              | Analysis of sizeable text repositories and using the inspiration of associative rule method in the natural language processing tasks  |
|                             | Wrocław University of Technology            | Faculty of Computer Science and Management (Department of Computational Intelligence)                          | Open language technology for the Polish language – natural language analysis, social phenomena analysis, social media analysis, scientometry, learning about science, processing and social networks and complex networks, natural language texts analysis, preventative algorithms and methods for data science, machine learning, analysis of network data structure with the application of deep machine learning. |
|                             | Poznań University of Economics and Business | Faculty of Informatics and Electronic Economy (Department of Information Systems)                              | Analysis of connotative text polarization, conducting research on language tools for the Polish language, e.g. lemmatization of proper nouns  |

# APPENDIX: SELECTED AI CENTRES BY SPECIALIZATION

| Specialization              | Institution                | Faculty, institute, department or laboratory  | Specialization details  |
|-----------------------------|----------------------------|---|---|
| Natural language processing | Adam Mickiewicz University | Faculty of Mathematics and Computer Science (Department of Natural Language Processing)                               | Open language technology for the Polish language – natural language analysis, machine translation, configurable processing stream for the Polish language, deep parser for the Polish language, research on the text classification, grammar mistake correction |
|                             | Adam Mickiewicz University | Faculty of Mathematics and Computer Science (Department of Computer Linguistics and Artificial Intelligence)          | A dialogue system with the database based on deep syntactic-semantic parsin, wordnet for the Polish language, a tool for morphological analysis and partial standardization of Polish text, a wordnet search engine   |
|                             | University of Łódź         | Faculty of Philology (Department of English Language and Applied Linguistics)   | Building of large monolingual and bilingual corpuses, conversational corpus, manual transcribing to the text  |
|                             | University of Warsaw       | Faculty of Mathematics, Informatics and Mechanics (Institute of Informatics)  | Deep syntactical-semantic analysis of the Polish language, semantic classification of text, using the language technology as part of the information search process   |
|                             | University of Warsaw       | Faculty of Polish Studies (Institute of Polish Language)  | Building the Polish language corpuses, language resources for the Polish language (e.g. the description of the nineteenth century language morphology)  |
|                             | University of Wrocław      | Faculty of Letters (Institute of Information and Library Science)   | Building of a unique chronological corpus of the Polish language along with the system for its statistical analysis, the application of natural language methods in media studies   |
|                             | University of Wrocław      | Faculty of Mathematics and Computer Science (Institute of Computer Science Computational Intelligence Research Group) | Superficial syntax analysis for the Polish language, morphosyntactical standardization  |

Source: OPI PIB study based on expert opinions prepared by: prof. W. Duch, prof. K. Jassem, prof. P. Kazienko, prof. J. Koronacki, prof. K. Krawiec, prof. H. Kwaśnicka, prof. J. Mańdziuk, prof. G.J. Nalepa, prof. M. Piasecki, dr A. Przeglasińska, prof. L. Rutkowski, prof. J. Stefanowski.

Read more at: [www.sztuczna inteligencja.org.pl](http://www.sztuczna inteligencja.org.pl)



digitalpoland



**DO YOU WORK IN ACADEMIA,  
DEVELOP AI IN POLAND  
AND WANT TO BE HERE?  
EMAIL US!**



**INFO@DIGITALPOLAND.ORG.PL**



**OPI@OPI.ORG.PL**



# AUTHORS

---

## NATIONAL INFORMATION PROCESSING INSTITUTE

[www.opi.org.pl](http://www.opi.org.pl)  
[opi@opi.org.pl](mailto:opi@opi.org.pl)

## DIGITAL POLAND FOUNDATION

 Łukasz Borowiecki – Expert

 Piotr Mieczkowski – Managing Director

[www.digitalpoland.org/en](http://www.digitalpoland.org/en)  
[info@digitalpoland.org](mailto:info@digitalpoland.org)

---

This report is a summary in English of an analysis prepared by National Information Processing Institute. Full analysis in polish can be accessed here:

[www.sztucznainteligencja.org.pl](http://www.sztucznainteligencja.org.pl)

