PoLAND of IT masters

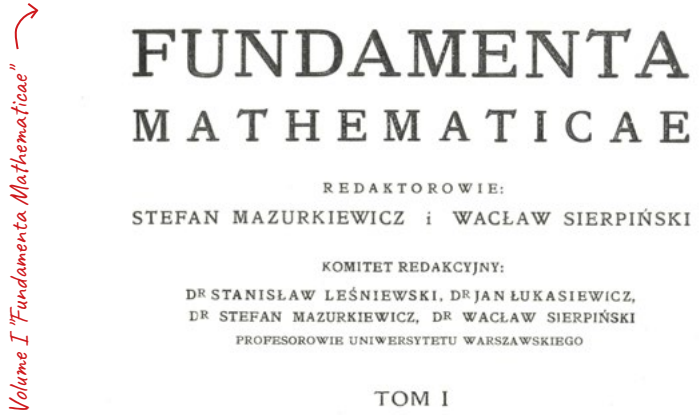
FROM THE POLISH SCHOOL OF MATHEMATICS TO THE POLISH SCHOOL OF ALGORITHMICS AND PROGRAMMING

– ABOUT IT SPECIALISTS, A POLISH GOLD MINE

It cannot be just a coincidence. Brilliant Polish mathematicians and cryptographers before World War II. Ambitious computer constructors after the war. Currently, the world elite of algorithmicians and programmers. Exact thinking, imagination, creativity, passion for creating and for pushing the limits – these are the features which distinguish and connect different generations – our hope for the future.

POLISH SCHOOL OF MATHEMATICS

After regaining its independence, Poland had great ambitions and dreams. People who wanted to think, create and work were its greatest treasure. It was reflected spectacularly in a difficult and hardly associated with the country's development science, that is mathematics. Several groups of leading mathematicians were formed around the John Casimir University in Lviv, the University of Warsaw or the Jagiellonian University. Their scientific works[1], recognisable in the world, created the concepts of Lviv, Warsaw and Kraków schools of mathematics – jointly the Polish School of Mathematics. Leading professors, such as Stefan Banach, Hugo Steinhaus, Wacław Sierpiński, Kazimierz Kuratowski, Stanisław Mazur, Stanisław Ulam, and others provided new insights into this field of study. With each new theorem, proof and concept, Lviv and Warsaw competed for the name of the world capital of mathematics.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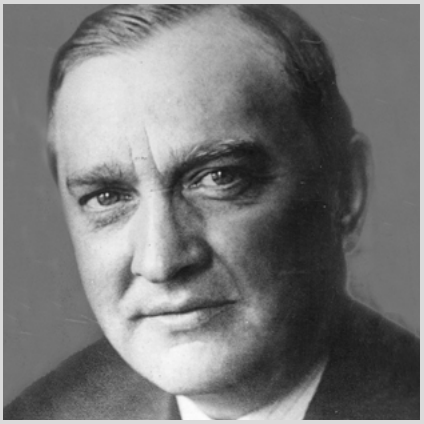


Prof. Stefan Banach

Particular attention should be drawn to the invention by Professor Jan Łukasiewicz of the basis for so-called Polish notation in 1920. Years later, it became the syntax for mathematical expressions used until today in calculators and some of the programming languages as the reverse Polish notation.

Prof. Stanisław Ulam

CRYPTOLOGY

Just a few days after regaining independence in 1918, by the decision of the Chief of State, the establishment of a surveillance unit was initiated in the forming army, and later on – it also dealt with decrypting of secret cables from countries endangering Poland of that time. The unit comprised of leading mathematicians and engineers. Thanks to their work, in the memorable year of 1920, the Polish leaders knew the cables of the Soviet army even before their recipients. Even though only recently disclosed, it contributed significantly to the decisions leading to victory.

Encryption techniques changed. Specially designed devices were introduced. They allowed not only for extremely elaborated encryption algorithms but also frequent changes to their so-called encryption keys. The most famous device was the Enigma machine. The method of decryption of its cables was developed by Polish mathematicians: Marian Rejewski,

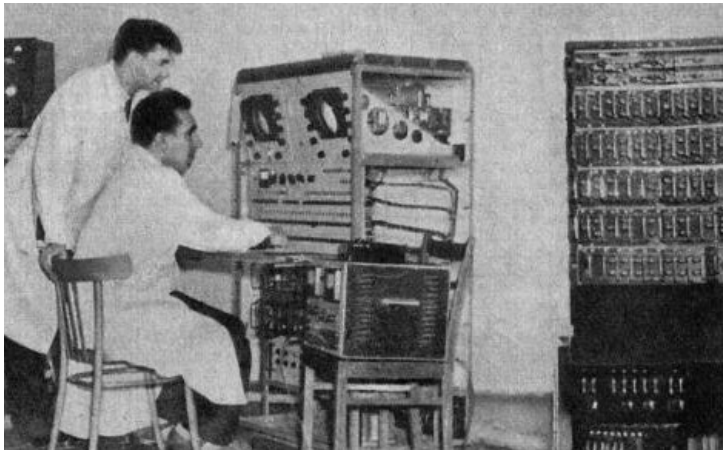
Workers in the Cipher Bureau, 1927

Jerzy Różycki and Henryk Zygalski. Their discovery could not have influenced the September defeat in 1939, but passing the knowledge on the Enigma's secrets to the French and British allies contributed not only to the success in the Battle of Britain but also affected the outcome of World War II. For many decades, the participation of the Poles was untold or marginalised. Today, however, we should remember and be proud of the fact that war successes were influenced not only by military forces but also by the power of minds of Polish mathematicians.

Group of Polish cryptographers, 1940-42

BEGINNINGS OF IT

The next release of the power of minds of Polish mathematicians and engineers was the decision (made in 1948 by the group of scientists under the supervision of Prof. Henryk Greniewski and inspired by the seminar of Prof. Kazimierz Kuratowski concerning electronic calculating machines) to build a Polish computer. Despite the post-war economic and political reality, the work



XYZ – the first Polish computer, 1958

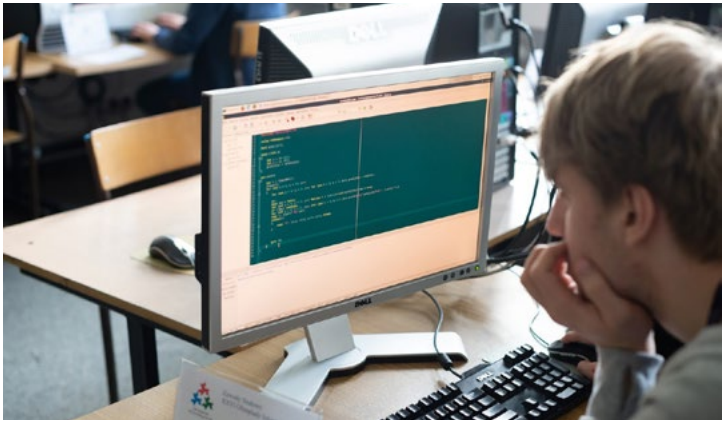
began in the destroyed Warsaw. Thanks to those bold visions, the Polish IT has started. The year 1948 is considered to be the year of its beginning. For the next years, the native electronic constructions of calculating machines (later called computers), like XYZ, UMC, ZAM, Odra or the K202 and Mera minicomputers, were created. But as time went by, their production was stopped due to technological and competitive reasons[2]. Hardly any other country was able to meet the requirements set by the extremely dynamic development of digital technology. Today, maybe three or four countries in the world create and develop the original construction of computers. On the other hand, manufacturing of their components and assembly works are performed in many other places.

Prof. Kazimierz Kuratowski

2 The Odra computers were manufactured until 1986 and the MERA minicomputers – until 1987.

TOWARDS SOFTWARE DEVELOPMENT

Lack of access to newer and newer technologies (hardware) did not block the second element of ICT systems, that is software. Even the development of software for XYZ was quite a challenge; however, it succeeded and this became one of the main assets of this machine. During the works on ZAM, it was agreed in advance that the crucial element of this project would be its software – the SAS [Symbolical Address System] micro assembler and SAKO [Automatic Operation Encoding System] the compiler of an algorithmic language, later called the "Polish FORTRAN". Its main creators were Leon Łukaszewicz and Antoni Mazurkiewicz – Polish IT pioneers.



Participant in the IT Contest

Open Days, Warsaw University of Technology

Software – it is where the Polish IT specialists found the space for unhindered development. Using the first computers manufactured in Poland or imported from abroad allowed for collecting strong knowledge base, experience and skills in using them. It provided the basis for cooperation as well as ambitious competition with the best in the world.

The Polish government, by putting a veto on the EU directive on patentability of software of 2004, became involved in the defence of small and medium software

companies. Adoption of this directive at that time would have created barriers impossible to overcome for young IT passionates not only in Poland but also in other European countries. In gratitude for this decision, Poland received over 30 thousand of messages saying – "Thank you Poland".

Creating software (and the word "creating" is not random) is often treated like creativity and it is subject to copyright. Polish IT specialists are among the world elite in this field. They are well-recognised and sought for. It is not just a derivative of the aforementioned schools of mathematics but, above all, the effect of lifelong cooperation between remarkable academic teachers and professors and algorithmically- and IT-minded youth.

IT fields of study were established in many academies, both universities and polytechnics, which allowed not only for teaching students but also for carrying out research and development activities concerning software and applications. Such fields of studies like algorithmic and programming were created in most of the departments of mathematics. This peculiar spirit of mathematics, present so strongly in Polish academies, shifted towards IT, and especially programming.

The main programming tools – programming languages, libraries or platforms are available to Polish IT specialist to the same extent as other IT specialists from any part of the world. Development of the Internet, and in particular its extent, availability and speed, allowed for effective involvement in building the digital world. Today, by working from Warsaw you can realise projects in cooperation with any centres all over the world.

Participants in the Baltie contest in 2013

POLISH MASTERS OF ALGORITHMICS AND PROGRAMMING

A system of education and competition for school pupils within the scope of IT Contest has been operating in Poland for more than a quarter of a century. Thanks to it, outstanding talents can be further developed under the supervision of the best teachers. In 26 years of participation of the Polish representatives in the International Olympiad in Informatics, we are ranked second (109 medals) in the world, just after China (119 medals), in the number of won medals. In the medal table we are in the fourth place, just after China, Russia and the United States. The Poles won 40 gold medals, 39 silver medals and 30 bronze medals. There are four Poles in the first top 10 of multi-medalists: Filip Wolski (4 gold medals), Andrzej Gąsienica-Samek (3 golds and 1 silver medal), Marcin Andrychowicz and Jarosław Kwiecień (3 gold medals each). Such cyclical events as Central European Olympiad in Informatics or Baltic Olympiad in Informatics also prove that Polish contestants are unmatched. Polish pupils have not been so successful in any other science olympiad for such a long time.

In 2003 the Poles were world champions in the ACM ICPC contest

The University of Warsaw team was world runner-up in 2012

Our students achieve similar results. In 2003, a team from the University of Warsaw, consisting of Tomasz Czajka,

Andrzej Gąsienica-Samek and Krzysztof Onak, won the first place in ACM ICPC [Association for Computing Machinery – International Collegiate Programming Contest] in Beverly Hills in California. This was neither the first nor the last success of young Polish IT specialists in the contest. Teams from the University of Warsaw have been participating in the ACM ICPC finals since 1995 – they often come back with a medal, and in 2007 they became World Champions again (in Tokio). At that time, their team was made up of Marek Cygan, Marcin Pilipczuk and Filip Wolski. The teams from the University of Warsaw also ended with a title of world vice-championship twice (in 2012 and 2017).

By the way, there is no other academy in the world that has been reaching the finals continuously for 25 years. Except for the University of Warsaw, other Polish academies are also successful in this prestigious IT academic event, in particular, the Jagiellonian University and the University of Wrocław. In 2012, the finals of ACM ICPC were organised in Warsaw – which meant appreciation and enormous prestige. Every year, the autumnal qualifying round gathers several thousand of academies and dozen thousand of teams from about 120 countries from all continents. Surnames of such professors as Jan Madey, Krzysztof Diks, Paweł Idziak

In 2007 the Poles were once again world champions in the ACM ICPC contest

The University of Warsaw team during the Finals in 2017

and Krzysztof Loryś are very well known in the world of IT. In 2017, the championship organisers awarded Professor Jan Madey with the Lifetime Coach Award for his remarkable achievements. One year later, such award was given to Professor Krzysztof Diks.

Prof. Jan Madey

Prof. Krzysztof Diks

Today we can easily talk about the Polish school of algorithmics and programming.

On this occasion, it is worth mentioning that many young IT specialists with international successes were under the supervision of the Polish Children's Fund for some time during their school terms. This fund is a unique society supporting the development of exceptionally gifted youth, through substantive supervision of the best Polish scientists as well as people of culture and art, for 35 years now. Its founder and the first long-standing leader was the late Prof. Jan Szczepański. Currently, this function is held by Prof. Jan Madey.

The aptitudes of young IT specialists are also confirmed by several other competitions, such as, for example, Imagine Cup organised by Microsoft or Hacker Rank for programmers. In the latter one, our countrymates are deemed the best in the world in Java programming.

Participants of the Polish finals of the IT Contest in 2019

GOLD MINE

At a time when working force is no longer sought for, but what is needed is a wonderful mind – these huge successes translate into many dimensions.

The largest IT companies in the world open their development centres in Poland and realise very serious projects there. Such giants as IBM, Intel, Google, Motorola, Ericsson, Samsung, Capgemini, and others hire from several hundred up to dozen thousand of specialists, competing for the best ones. They create jobs in Warsaw, Wrocław, Gdańsk, Katowice, Rzeszów, Kraków – as the best IT specialists do not always want to leave their city and the technology allows for remote collaboration. Polish centres participate in global digital development.

Some of them, however, fulfill their ambitions and pursue their passions among the world's best IT specialists in laboratories of Elon Musk or the Apple, Google, Microsoft and Amazon companies. The winners of olympiads and world championships in programming are on the leading edge. Naturally, being the pride and joy of the Polish IT, they search for challenges at a global level and fulfill their ambitions among the best ones.

Mission of the Dragon spacecraft, which supplies the International Space Station

Tomasz Czyjka

Jakub Pachocki

In Elon Musk's programme called SpaceX, Tomasz Czajka creates control software for the Dragon vehicles, which transport astronauts to a space station. Filip Wolski works on developing artificial intelligence in the Open AI company.

Marek Cygan

Filip Wolski

Four Poles, including Jakub Pachocki, were members of the team working on the computer programme using machine learning methods, which beat the world champions in a computer game called Dota2, played by several hundred millions of players. Krzysztof Onak develops his talent in IBM T. J. Watson Research Centre supporting the development of products known all over the world. Andrzej Gąsienica-Samek is a founder of the Atinea company and Marek Cygan is an originator of the NoMagic AI company, which deals with programming of robots. These examples can be multiplied over and over again.

Professor Krzysztof Diks said that while walking on the Google campus he felt like on his own academy – every couple of steps he heard "Good morning, professor".

International Collegiate Programming Contest gaming room in 2018

STRONG IT SECTOR

The most important effect of the developing IT sector is its impact on the growth of Polish economy. Value of the Polish IT market reached PLN 65 billion in 2018, and its growth rate almost doubled the average growth of global IT by reaching 7.2% in 2018 (the report "Top 200" in the weekly "Computerworld" from 2019). Original Polish technologies, products and services have a growing share in the aforementioned value.

President of Asseco Poland S.A. – Adam Góral

President of Comarch S.A. – Prof. Janusz Filipiak

Polish IT companies are becoming more and more daring in winning international markets. The "Asseco" company from Rzeszów, founded by Adam Góral, is the largest Polish software maker and one of the largest in Europe. It is present in over 50 countries and employs about 25,000 people. Experts from Asseco combine the expertise in new technologies and specific sectors of the economy like, for example, banking, finances, energy industry, telecommunications, health and public administration. This allows the company to develop IT products that meet real needs of customers and to carry out innovative implementations all over the world. On the other hand, the Comarch company is an example of an undertaking created at the University by Prof. Janusz Filipiak and a group of his students. Today, the company

employs over 5,500 specialists, developing and selling its products to over 30 countries.

We provide traditional IT solutions, like business systems supporting telecommunications and energy industry, developed by globally renowned Polish suppliers, like Asseco and Comarch, but creative, well-educated and resourceful Polish IT specialists often pursue their professional ambitions in their own technology start-ups. Many of them successfully compete in international markets, in such areas as new-generation digital marketing (e.g. Synerise or Divante), industry 4.0 (AIUT or VersaBox) and advanced artificial intelligence (DeepSense.AI).

However, we cannot look only at the IT market when assessing the importance of information technology – „a Polish gold mine", as the growth of the ICT industry stems from digital transformation of many other economic sectors. Within several decades,

Maciej Popowicz, Ten Square Games

modern financial services based on non-cash transactions have been established and mobile telecommunication and multimedia services have spread across the country. Digitalisation is identified by Polish policymakers as one of the basic elements of the national strategy for economic development, which is based on innovation and intellectual capital. Where Polish transformation meets new trends in the development of technologies and their application, the Poles actively use their talents in the scope of technology. They participate in the global competition between innovative products, services and business models across various markets. The Polish video games industry makes a special example here.

VIDEO GAMES

This sector is defined as part of the broadly defined entertainment industry; however, technologies creating gaming platforms, game engines and finally – products for end-users, are an immanent

Adam Kiciński, President of CD Projekt S.A.

feature of the sector. The value of the video game industry has exceeded the value of film production, therefore global successes of such titles as Call of Juarez, The Witcher, Frostpunk or This War of Mine are more than just promotion of the Polish entertainment creativity and technological

The Witcher, CD Projekt

competence. The companies like CD Projekt RED, 11 bit studios, Techland or CI Games are not only recognised global players but also a steadily growing part of the Polish economy and capital market. Polish games win spectacular artistic successes (for example this year's nominations for the most prestigious awards – The Game Awards and BAFTA for Frostpunk) and business successes. The sale of Frostpunk covered the costs of many years of development in just first 66 hours, whereas

Frostpunk, 11 bit studios

Cyberpunk, CD Projekt

one week before its release, the third part of the cult Witcher reached one million of sold games. However, we mostly speak of companies with multi-billion capitalisation, employing hundreds of people and creating – like for example 11 bit studios – interesting support programmes for independent game manufacturers, whose sector grows rapidly. We also participate in the vast market of mobile games, for example, Vivid Games from Bydgoszcz or the successful Ten Square Games

Wild Hunt, Ten Square Games

founded by Maciej Popowicz, award winner of IT Olympics, creator of the "Nasza Klasa" social networking site. Each day, about 20 million users around the globe play games developed by Ten Square Games.

Going back to the previously presented Polish speciality, that is ciphers, it is worth knowing that after its accession to NATO, Poland provided the organisation with the PEM-HEARDT system, which is still in use for encryption of information in NATO's ICT networks.

Digital technology, which surrounds us, is one of the most important factors impacting our present and future. It is no wonder that all countries in the world want to participate in its development and benefit from it. Poland contributes its most precious potential, a special intellectual potential developed for generations. Formerly the Polish School of Mathematics – today the polish school of algorithmics and programming.

Włodzimierz Marciński
President
of the Polish Information Processing Society

List of illustrations

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p. 5	participants in the Baltie contest in 2013: Małopolska Branch of the Polish Information Processing Society materials;
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p. 10	Marek Cygan, Filip Wolski: materials of the portrayed persons; International Collegiate Programming Contest gaming room in 2018: photo from the collection of Prof. Jan Madey;
p. 11	President Adam Góral: press materials of Asseco S.A.; Prof. Janusz Filipiak: press materials of Comarch S.A.;
p. 12	Maciej Popowicz: materials of the portrayed person;
p. 13	President Adam Kiciński: materials of CD Projekt; The Witcher: press materials of CD Project; Frostpunk: press materials of 11 bit studios;
p. 14	Cyberpunk: press materials of CD Projekt; Wild Hunt: press materials of Ten Square Games;
p. 15	President Włodzimierz Marciński: The Polish Information Processing Society, photo Anna Andraszek; code: Unsplash, Markus Spiske (converted);
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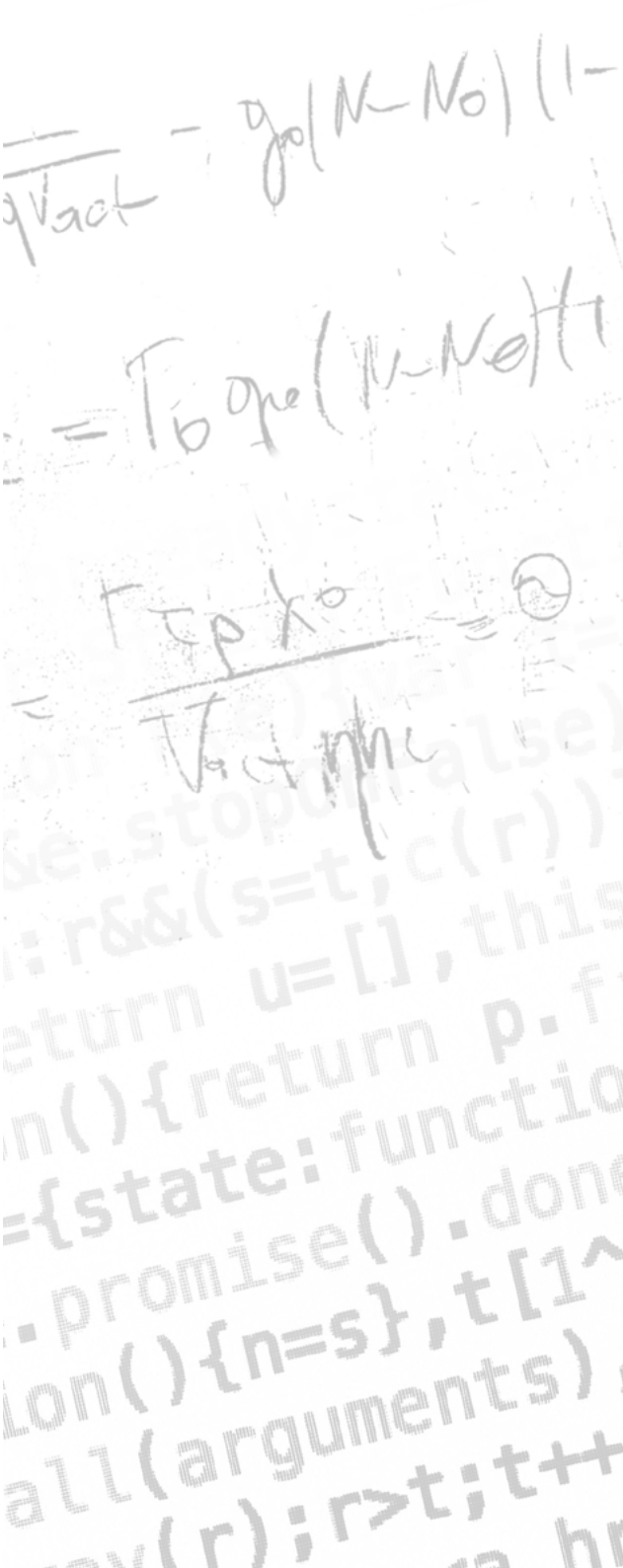

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