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Digital Humanities: The Explosive Rise of Computer Technology

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Digital humanities, computer history, and digital agriculture are the most striking evidence of the widespread penetration of computer technology into all spheres of human life.

November 10–12, 2021 Moscow hosted the 7th HISTELCON International Conference — the flagship conference of the IEEE European Chapter, which brings together more than 400,000

individual members working in more than 40 IEEE communities in the field of new technologies and their impact on social and economic development humanity. The IEEE Society on Social Implications of Technology (SSIT) is among them, which was founded in 1972. The main area of interest for SSIT members is to maintain a professional dialogue on the study of the impact of new technologies, particularly digital technologies, on the development of humanity and their relationship with society's social life. The motto of the IEEE is: Advancing Technology for Humanity.

Science and society, science and technology policy, communications in science, mobility of scientists, sociology of science, women in science, assessment of the activities of scientists and research teams, science and education, social problems of modern technologies — these are the topics that were discussed at HISTELCON-2021.

Holding the HISTELCON-2021 conference in Moscow is a sign of respect for the outstanding achievements of Russian and Soviet science. Seventy years ago, in December 1951, the first Soviet computers M-1 and MESM were created. The Soviet Union was one of the three countries that were the first to enter the era of computer technology.

The conference was also timed to coincide with the 90th anniversary of the Institute for the History of Science and Technology of the Russian Academy of Sciences, celebrated in 2022.

Most of the reports presented at the conference considered the development of computer technologies and their applications in dynamics, how their achievements could affect the future.

Keywords: digital humanities, computer technology, science and society, women in science, social problems of modern technologies, IEEE, HISTELCON, IHST.

The digital humanities, computer history, and the digital agriculture are the most striking evidence of how widespread computer technologies are in all spheres of human life.

Science and society, science and technology policy, communications in science, mobility of scientists, sociology of science, women in science, assessment of the activities of a scientist and research teams, science and education, social problems of modern technologies — these are the topics that were discussed at the HISTELCON-2021 conference. The organizers of the conference, which was held from November 10 to 12, 2021, are the Institute for the History of Sciences and Technology of the Russian Academy of Sciences, National Research University “Higher School of Economics”, Institute for System Programming of the Russian Academy of Sciences.

HISTELCON is the flagship conference of the European branch of the IEEE, the oldest and largest community of specialists, uniting about 440 thousand individual members working in electronics and its applications, including the social aspects of introducing new technologies. IEEE's motto is: Advancing Technology for Humanity.

The IEEE Society on Social Implications of Technology (SSIT) was founded in 1972. The main area of interest for members of SSIT is maintaining an ongoing public and professional dialog on technologies such as *BioTech*, *Big Data* and how they relate to social life in areas such as privacy and ethics.

The flagship conference is held directly under the leadership, which, on a competitive basis, determines the country that is entrusted with the holding of the next conference. Holding the HISTELCON-2021 conference in Moscow is a sign of respect for the outstanding achievements of Russian and Soviet science. 70 years ago, in December 1951, the first computers M-1 and MESM were created. The Soviet Union entered the top three countries that were the first to enter the era of computer technology.

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There were 29 presentations made at the conference by 51 authors from 14 countries. The majority of papers were dedicated to the following topics:

- Social and Industrial Aspects of Computer Technology Applications;
- Computer Technology and Museums of the Future;
- Education and Computer History;
- History of the Evolution of Computers and Developer Teams.

Most of the reports looked at the dynamics of development of computer technologies and their applications, at how previous technological achievements could affect the future. First of all, this applies to invited reports.

In *Yuri Baturin's* (Institute for the History of Science and Technology, Russia — IHST) paper “Limits of ‘the Self’, boundaries of Personal space and IT”, the problems of personal autonomy and privacy that have arisen with the rapid development of information technology are explored. The concept of personal space is introduced using a systemic approach and the foundations for a theory of personal space are suggested. The conclusion is made about the pulsating nature of personal space boundaries. The influence of information technology on the dynamics of personal space boundaries is considered. The proposed approach is extended to neuroinformational technologies. The phenomenon of personal space narrowing inside the person’s mental sphere and the individual’s reaction to blocking external influences are discussed. It is emphasized that the current legislation does not regulate the relations arising in the process of neuroinformational interaction. Since the rate of IT progress is incompatible with the traditionally conservative nature of the legislation, it is suggested that the solution to this contradiction should be sought in the area of experimental jurisprudence. More details about the report can be found at the link DOI: 10.1109/EnT52731.2021.00012.

Giovanni Antonio Cignoni's (Hacking the Macchina Ridotta project, Italy) paper “Museums of the future: computer technology in the museum of technology” was concerned with the experiences in building and usage of old computing devices for exhibitions and educational activities. Computer science has always been concerned with reproducing the real world in the form of data, making it abstract to handle it better. Today achievements in virtual reality have a terrific ability to attract the public’s attention. Combining these two qualities allows you to take a fresh look at how a computer museum of the future should look like, and in the future, any museum of technology. Computers are devices made to run software programs: old computers should be exhibited running. Unfortunately, old machines still in working condition are scarce. Restoring or rebuilding an old computer is a hard, expensive task: the original components are rare and the technology is forgotten, sometimes lost. The research needed to understand those computers has to adopt experimental archaeology methods: rebuilding old hardware / software requires to proceed by hypotheses and experiments. However, a rebuilt or restored computer is a unique exemplar and a precious specimen. But it is not suitable for interacting with people. A more flexible solution is to build virtual replicas by using software simulation. First of all, simulation is a valuable tool to carry out the experiments needed to study past technologies. Second, simulators let people interact with the old machines, thoroughly enjoying the experience without risks for the precious devices. 3D visualization techniques can make the close encounter more immersive and appealing.

In *Igor Agamizian's* (National Research University “Higher School of Economics”, Russia — HSE) presentation “Computing in Russia: Thirty Years after the USSR” the evolution of the computer industry in Russia was analyzed. At the time of the collapse of the

USSR, the country was uncompetitive in microelectronics (with a technological lag of 5–6 years), there was a complete absence of a modern computer base (only personal computers based on 8086 appeared) and complete absence of the software industry.

Ten years later, we were still far behind the developed countries. The number of computers in Russia was about 7 million — about 5 per 100 inhabitants (48 in Japan, 62 in the USA). Internet access was available to approximately 2.7% of Russian residents (16% in Japan, 53% in the USA).

Now Russia has become one of the global leaders in Internet penetration. A significant number of Russian software vendors became visible and popular on the global market: ABBYY, Parallels, Acronis, Kaspersky Lab. Local software vendors have become super competitive on the domestic market. On May 24, 2011, the first IT IPO took place. Russian internet company “Yandex” has successfully completed its first IPO in the United States. State became the main domestic customer of IT systems developers and integrators. Some efforts were applied for the domestic microelectronics development — Baikal, Elbrus. Platform software development based on Open Source (Linux, PostgreSQL) was developing. Private digital business ecosystems are emerging fast (Yandex, Sber). There is a huge demand for skilled personnel to develop and maintain IT systems. Significant efforts are being made to develop IT education.

The report by *Marina Smolevitskaya* (Polytechnic Museum, Moscow, Russia) “Women in the computer world of the USSR and Russia” was dedicated to women — the pioneers of the world of computers in the USSR. This topic and a more general topic — the women of Russia in the world of science — is understudied. It is in stark contrast to Western countries, where a large amount of research is devoted to women in science and engineering. The first electronic digital computers in the USSR were developed and built in the early 1950s. Among the first computer engineers and programmers of the USSR, there were many women who, in the conditions of a shortage of literature and a practical lack of experience, quickly and successfully mastered new professions and achieved success in them, were project leaders, scientific directions. Their achievements and contribution to the development of computer informatics in the USSR were very significant. More details about the report can be found at the link DOI: 10.1109/EnT52731.2021.00009.

Pierre Mounier-Kuhn's (CNRS, Sorbonne Université & Center A. Koyré / CRHST, France) paper “The beginnings of electronic computing in European and Soviet countries. A comparative sketch” was devoted to the beginning of the use of computers in France and in the USSR. The report traces the history of the development of computing in France and the USSR during the XX century: from adding machines to modern computers. The first stage is desktop calculators, numerical methods development, and the first programs (instructions for calculations). Further, in the 1950s, the first electronic computers emerged, the transition from machine code to programming languages took place. The next stage is the formation of systems programming discipline, the desire to create a universal programming language. And finally, new challenges: automatic translation, cryptography, automatic preparation of documentation and information retrieval, “smart things”, real-time systems. Crucial Factor: Demand for trained programmers and computer engineers. Widespread use of computer technology not only in science, but also in management and business.

In *Yuri Baturin's* report “Artificial intelligence as a post-stage of natural intelligence” the problem of creating artificial intelligence is discussed. It is argued that creating it on binary computers is a deadlock. It is proposed to move from binary logic to ternary and then

to multivalued or fuzzy logic as a first step. Blockchain technology makes it possible to back up the thinking of a particular individual, for example, for medical purposes to restore a person's memory after amnesia. In the following experimental stage, an object with elements of both natural and artificial intelligence is created, which can be used to retrieve answers from a person who has already passed away. In this sense, the created complex intelligence can be considered as a post-stage of natural intelligence. To create artificial intelligence is necessary to connect thought chains recorded from different people, then solve the problem of “gluing” trees with other hierarchies, association formation systems, and cause-effect relationships, and move from ternary logic to multivalued or fuzzy logics. More details about the report can be found at the link DOI: 10.1109/EnT52731.2021.00007.

Vasily Burov (HSE), *Sergei Prokhorov* (IHST) presented the report “The role of computer users associations in the development of software in the USSR”. For many years in the Soviet Union, all works related to computers were strictly classified. With the advent of the Ural and M-20 series computers, work on computer topics was declassified. But due to strict censorship and planning, there were no computer literature, no training courses, and teachers. Much effort has gone into creating a structure that, to some extent, has eased the tight grip of censorship and strict planning. The Commission for the Operation of M-20 Computers under the Presidium of the Academy of Sciences became a very influential organization that had a very significant impact on the creation and development of subsequent associations (commissions), which made it possible to at least partially eliminate the problems associated with censorship and strict planning. This topic is also discussed in detail in the recently published article by Sergei Prokhorov, “Experience in standardization of programming languages for mini- and microcomputers”, DOI: 10.1109/EnT52731.2021.00008.

Giacomo Bucci (University of Florence, Italy) presented the report “A personal collection to an educational exhibit of the advancement of computer technology”. At the School of Engineering of the University of Florence, the implementation of a small “museum” of computers and related equipment is underway. The aim is to make visible to the large student population of the Faculty as many as possible electronic devices and equipment related to the field of computers, belonging both the past and recent technology. The emphasis is to illustrate the fast rate of advancement in this particular field of electronics.

Not all the abandoned equipment was always thrown away; part of it remained on the shelves. At a certain point, university employees decided to collect the survived pieces as a coherent exhibit, which could also support the teaching activities. Naturally, also objects coming from the external world have been added. As a complement to the exhibit, a documents are provided in which all the exposed elements are described in some detail.

Irina Kraineva, *Olga Savelova* (A.P. Ershov Institute of Informatics Systems, Russia) presented the report “The female face of programming (the mid–1950s — early 21st century)”. The article details the biographies of three women representing three successive generations in computing and programming. They worked with perseverance and determination to achieve the goals set in their academic careers. They have also demonstrated a high level of competence and ability to develop strategies in various social, political, and economic situations. In addition to reconstructing the biographies of these three scholars from documents and memories, some research (using a microanalysis strategy) was carried out to determine how general and specific gender imperatives influenced their view of the world and quality of life. General gender imperatives stem from the androcentric or feminist worldview, and specific gender imperatives are manifested in problematic situations related

to career, self-realization, double standards, etc. All three women are associated with the Soviet / Russian Academy of Sciences, hold a mathematics and computing degree, and specialize in programming.

All presented papers will be published in the conference proceedings, posted in the famous electronic library *IEEE Xplore*, indexed in the authoritative abstract databases *Scopus* and *WoS*. A decision was made to hold annual scientific conferences on the history of the development of modern technologies and their impact on the social and economic development of society.

More detailed information about the 2022 conference will be posted on the Institute for the History of Science and Technology website — <http://ihst.ru/en/>.

Цифровые гуманитарные науки: резкий рост компьютерных технологий

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Цифровые гуманитарные науки, компьютерная история и цифровое сельское хозяйство являются наиболее ярким свидетельством проникновения компьютерных технологий во все сферы жизни человека.

10–12 ноября 2021 г. в Москве состоялась 7-я Международная конференция *HISTELCON* — флагманская конференция Европейского отделения *IEEE* (Институт инженеров электротехники и электроники), которое объединяет свыше 400 тыс. индивидуальных членов, работающих в более чем 40 сообществах *IEEE*. Среди этих сообществ — *IEEE Society on Social Implications of Technology (SSIT)*, основанное в 1972 г. Основная сфера интересов членов *SSIT* — поддержание профессионального диалога по изучению влияния новых технологий на развитие человечества и их связь с жизнью общества. Девиз *IEEE*: «Разработка технологий для человечества».

Наука и общество, научно-техническая политика, коммуникации в науке, мобильность ученых, социология науки, женщины в науке, оценка деятельности ученых и научных коллективов, наука и образование, социальные проблемы современных технологий — темы, обсуждавшиеся на *HISTELCON-2021*. Большая часть докладов конференции была посвящена развитию компьютерных технологий и их приложений с точки зрения влияния на будущее. Проведение конференции *HISTELCON-2021* в Москве — знак уважения к выдающимся достижениям российской и советской науки. Семьдесят лет назад, в декабре 1951 г., были созданы первые советские ЭВМ М-1 и МЭСМ. Советский Союз стал одной из трех стран, которые первыми вступили в эпоху компьютерных технологий. Конференция также была приурочена к 90-летию Института истории естествознания и техники им. С.И. Вавилова Российской академии наук, отмечаемому в феврале 2022 г.

Ключевые слова: цифровые гуманитарные науки, компьютерные технологии, наука и общество, женщины в науке, социальные проблемы современных технологий, *IEEE*, *HISTELCON*, *IHST*.