

Computing and Computer Science in the Soviet Baltic Region

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In the context of a big country

- Computing in the Soviet Union was considered as a part of cybernetics – a “capitalist pseudoscience” in the fifties, hence publicly nonexistent, although computers were used already by physicists and space engineers.

In the context of a big country

In March 1955, a special governmental committee prepared a classified report and emphasized the Soviet lag in communications engineering, control engineering saying: *“As a result of irresponsible allegations by incompetent journalists, the word “cybernetics” became odious and cybernetic literature was banned, even for specialists, and this has undoubtedly damaged the development of information theory, electronic calculating machines, and systems of automatic control.”*

In his article in 1958, A. Kolmogorov defined cybernetics as a discipline studying *“the methods of receiving, storing, processing, and using information in machines, living organisms, and their associations.”*

The first graduates in CS

- It was suddenly decided in the SU in 1958 that a larger number of computer experts are urgently needed for defense and space industry. Several hundred young physicists, mathematicians and electronic engineers were reeducated in two years in LTU and MEI providing them as good education in computing as it was possible in those days.
- Among the graduates of these classes were ten Estonians and a larger number of Lithuanians who then returned to their countries.
- The first CS graduates in Estonia came from Taru University in 1960 – by the initiative of Ü. Kaasik.

A CS curriculum (1959-1961)

- Ordinary differential equations – 90
- Algebra – 90
- Functions of a complex variable – 90
- Probability theory and statistics – 105
- Partial differential equations – 30
- Numeric methods – 60
- Programming – 55
- Control theory and tracking systems – 204
 - Semiconductors and magnetic elements – 60
 - Electronic devices – 150
 - Theory of electric circuits – 60
 - Arithmetic and logic of computers – 45
 - Theory and design of analog computers – 90 (+180)
 - Theory and design of digital computers – 108 (+206)

Lithuania

- A computer factory was founded in Vilnius in 1960 (?). The graduates from Leningrad Technical University were the first qualified computer engineers at the factory. It became a large company *Sigma* that operated until the end of the SU.
- *Ruta-110* was one the most popular computers produced by *Sigma*.

Ruta-110

- “RUTA-110” - complex of devices of processing, input, storage, output, and also remote collection and output of the alphanumeric information intended for creation of local systems of data processing. It was developed in 1969 in Vilnius. The structure of the processor and peripherals, and also command system are developed taking into account requirements of processing of large scale arrays of data when solving a wide range of economical, administrative and other tasks.

CS in Lithuania

- Two CS research centers in Lithuania:
 - Kaunas (Henrikas Pranevičius) --formal specification, validation and simulation of distributed systems.
 - Vilnius (Laimutas Telksnis) – networking, data mining

CS in Latvia

- CS mainly in Riga – university and polytechnical institute both had research groups.
- Janis Barzdins, a graduate student of B. Trakhtenbrot obtained fundamental results in inductive inference, later applications in program synthesis from examples.
- R. Freivalds, I. Etmane, ... -- logic and its applications in CS.

CS education in Leningrad

- Leningrad had good computer science and engineering education in many universities.

The educators and research leaders in the sixties were T. Sokolov (LPI), V. Smolov (LETI), Maierov (LITMO).

The research started later also in Leningrad University – S.Lavrov, G. Tseitin and many others.

A strong research group was in the Computer Center of LOMI – lead initially by N. Boldyrev and later by V. Varshavski.

CS research in Leningrad

- But paradoxically, few widely known results in computer science came out from Leningrad, obviously because of the confidentiality of many works performed in military institutions of this city.
- This kind of an institution was a Construction Bureau-2 (KB-2) of Electronic Technology headed by Philip Staros (Alfred Sarant).

Estonian contacts with Leningrad

- *Svjatoslav Lavrov* and *Viktor Varshawski* were the most supportive to young Estonian researchers.
- Leningrad Division of Mathematical Institute of the Soviet Academy of Sciences (LOMI). A logician *Nikolai Shanin* and his group had a strong influence on Estonian computer science. The members of this group *Sergei Maslov* (proof theory), *Anatol Slisenko* (recursion theory), *Grigori Mints* (proof theory), *Yuri Matijasevich* (algebra and logic) have all influenced Estonian theoretical computer scientists.

Institute of Cybernetics of Estonian Academy of Science

- Early Estonian computing was influenced by the fact that Institute of Cybernetics was founded in Tallinn in 1960, primarily by initiative of Nikolai Alumäe, who needed computers for his research in dynamics of thin shells (submarine hulls).

First computer built in Estonia

- The Institute of Cybernetics was the place where the first digital computer M-3 was built in Estonia in 1960. It had been originally designed in Minsk, but was significantly improved by adding a core memory instead of a much slower magnetic drum. This increased the performance of the computer considerably.
- The Institute of Cybernetics became a leading research center in computer science and computer applications in the Soviet Baltic region.

STEM – the first digital computer designed and built in Estonia in 1962-1964



16-bit processor on
ferro-diode components;

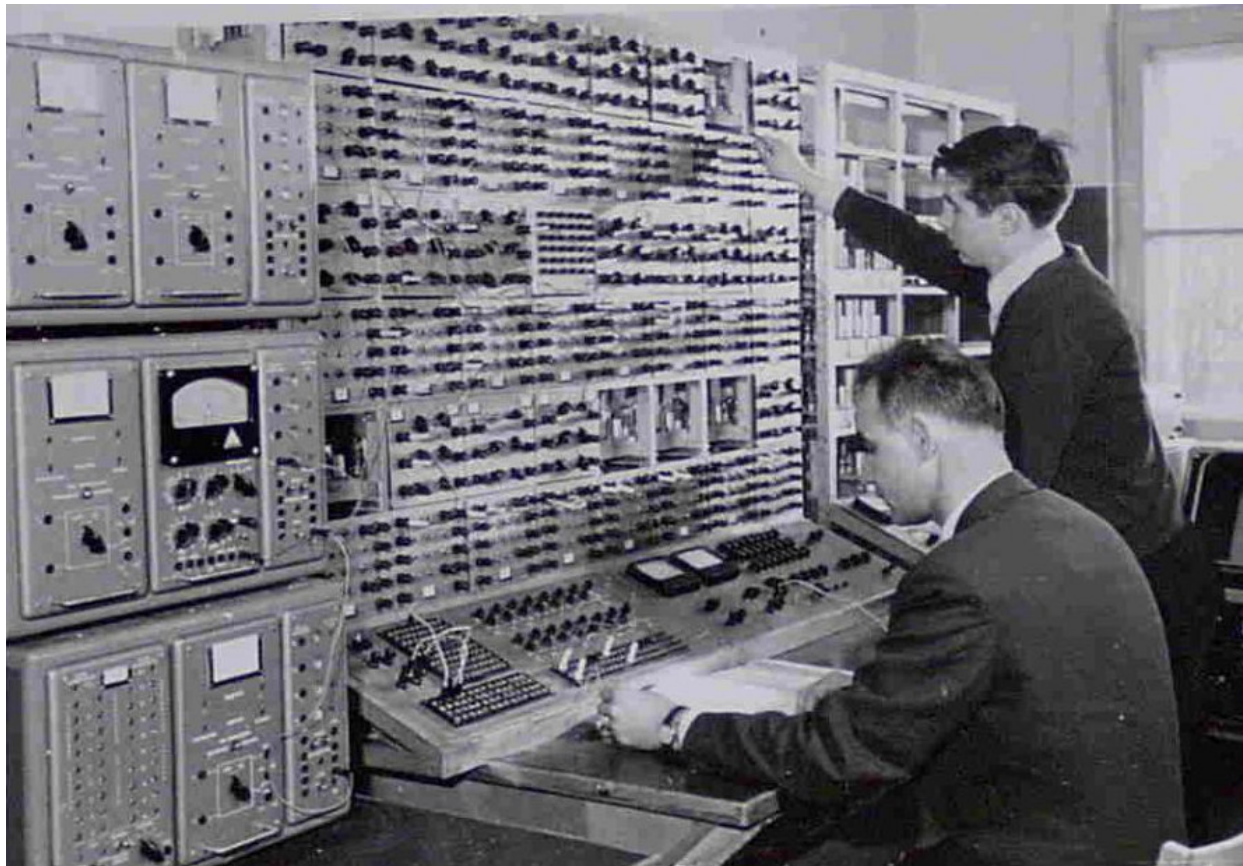
Interactive IO using
electric typewriter;

Small ferrite RAM;

Large ROM;

Software for engineering
problems;

The first analog computer built in TPI, 1959



Early research (60-s)

- Early research in computer science in Estonia was mainly in programming languages. This was language design, syntactic analysis and compiler construction.
- A language called MALGOL (modular Algol) was developed and widely used on popular Minsk computers (M. Kotli).
- Mati Tombak became the leader of research in syntactic analysis, and a number of Ph.D theses were written in this area. Success in syntactic approach inhibited deeper interest in semantics of computations for years.

Large applications

- On computer applications side, there was an information system project for a large wholesale warehouse of Estonian Consumers Cooperative Society (ETKVL) that was completed in the sixties. This project was well supported by the ETKVL administration, attracted good software developers due to the best working conditions and salaries, and became a success case of a large information system development in the Soviet Union.

Another long-lasting and quite successful information technology project in Estonia was computer control of chemical processes in the oil shale chemistry, done by researchers of the Institute of Cybernetics and supervised by Raul Tavast in the seventies.

Domain-oriented languages and IDE

- The first remarkable result was development of a language and environment SAP-2 for NC of machine tools in Estonia in the beginning of sixties. The system SAP-2 was introduced in the Soviet aviation industry and gave a good position for its main developer Boris Tamm in the Soviet computing.

Another group of researchers (E. Tyugu et al) developed and applied in industry a modular programming environment SMP also in the end of sixties. This became a starting point for research in software engineering here, because SMP supported a well-defined software technology and documentation. This research direction continued by development of structural synthesis of programs and its implementation in several software tools (PRIZ, MicroPRIZ, NUT).

CAD/CAM applications

- The first engineering applications were optimization programs for machine tools – cutting conditions, processing time etc. for Putilov plant in Leningrad in the sixties.

Larger applications were for Elektrosila plant in Leningrad and rocket engines plant in Dnepropetrovsk (70-s).

Later applications in power semiconductor design and technology for Tallinn Electrotechnical plant(80-s).

A survey of research topics, 70/80

- Research in databases (A. Isotamm, A. VILLEMS, A. Kalja, H.-M. Haav).
- Control theory and computer control (Ü. Kotta, R. Tavast, L. Mõtus).
- Systolic algorithms and FFT (I. Arro, T. Plaks).
- Synthesis of programs (E. Tõugu, G. Mints).
- Attribute grammars (J. Penjam, M. Meriste).
- Expert systems and knowledge representation (J. Tepandi, E. Tõugu, M. Koit).
- Logic, in particular, proof theory, realizability, model checking (G. Mints, T. Tammet, S. Tupailo).
- Software environments (B. Tamm, J. Pruuden, M. Matskin, S. Shmundak).
- Test generation (R. Ubar).
- Automata theory (G. Jakobson, P. Leis)

Automata theory, recursion theory

In the beginning of seventies, Wilhelm Kracht introduced automata theory in his seminars to young scientists. Soon it gave output in the form of Ph.D theses on decomposition of automata (Gabriel Jakobson, Andres Keevallik, Paul Leis). This research domain became practically widely recognized many years later, when fast computers and new challenges in chip design appeared.

J. Henno was one of the first Estonians studying CS abroad. He worked in the group of A. Salomaa in Finland in 1976 on the complexity of multiplace functions.

Computer Design Office EKTA

- An important milestone of computing in Estonia was founding of the *Computer Design Office* (EKTA) of the Institute of Cybernetics in 1976.
- Due to personal contacts of its scientific leader *H. Tani* with German engineers as well as with researchers in the Soviet Union, EKTA got advanced microprocessors and printed circuits technology, and evolved into a leading center in design and application of microprocessor systems in the Soviet Union.
- EKTA designed and manufactured a number of personal computers "Juku" for Estonian schools in 1988. It was a dream that success of this project would have the influence on education in Estonia comparable to the publication of bible in the native language in the eighteenth century.

Scandinavian contacts

- Although Estonia was behind the iron curtain, the country had better contacts with the West in computer science than most parts of the Soviet Union had it.
- There was a special agreement on scientific cooperation between Estonia and Finland in the field of computer science. This was mainly handled without interference from Moscow. Finnish scientists (Reino Kurki-Suonio, Markku Syrjanen, Hannu Jaakkola and many others) were frequent visitors in Estonia.

Scandinavian contacts continued

- Good contacts were established with Denmark (Dines Björner) and Sweden (Bengt Nordström's group and Jan Smith in particular, Per Martin-Löf) in eighties.

Eric Sandevall from Linköping sent a source code of Interlisp when it was a popular AI programming tool to the Institute of Cybernetics, and helped in this way the researchers in artificial intelligence to become a part of international AI community.

Estonia became a meeting place of western and eastern computer scientists where numerous meetings were held, because it was easily accessible from both sides, especially by ferry from Helsinki from the West.

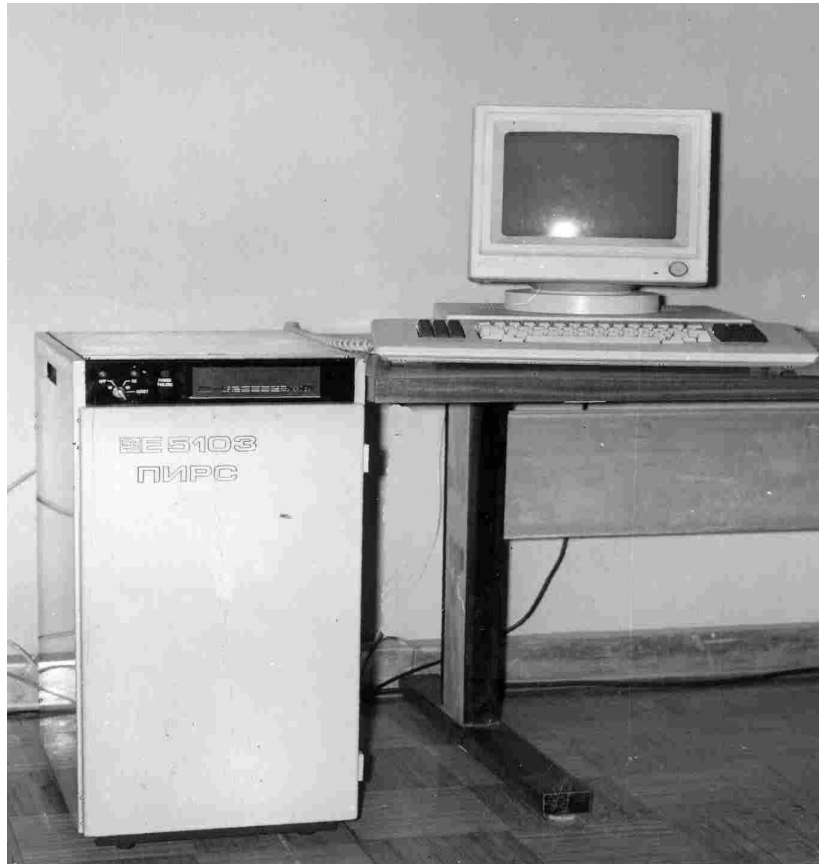
Leagues A and B in the Soviet CS

- League A: Some institutes in Moscow and Novosibirsk, military institutions, computers M20, Besm, Elbrus etc.
- League B: Institutes outside Russian Federation, Ural and Minsk series computers.
- Institute of Cybernetics got operational Elbrus-1 in 1987, but we had good contacts with researchers of the league A beginning from 1968.

START project

- Official goal: to develop new high-performance highly parallel hardware and intelligent software (like the Japanese 5-th generation).
- The aim of the initiators of the project was to get better resources for testing their ideas in computer architecture (V. Kotov), application software (V. Brjabrin) and intelligent software (A. Narinyani, E. Tyugu).
- Direct support from G. Marchuk gave good resources.
- Results in Tallinn: NUT and PIRS; in Novosibirsk: KRONOS and MARS; in Moscow: application software for PC-s.

Workstation PIRS in 1988

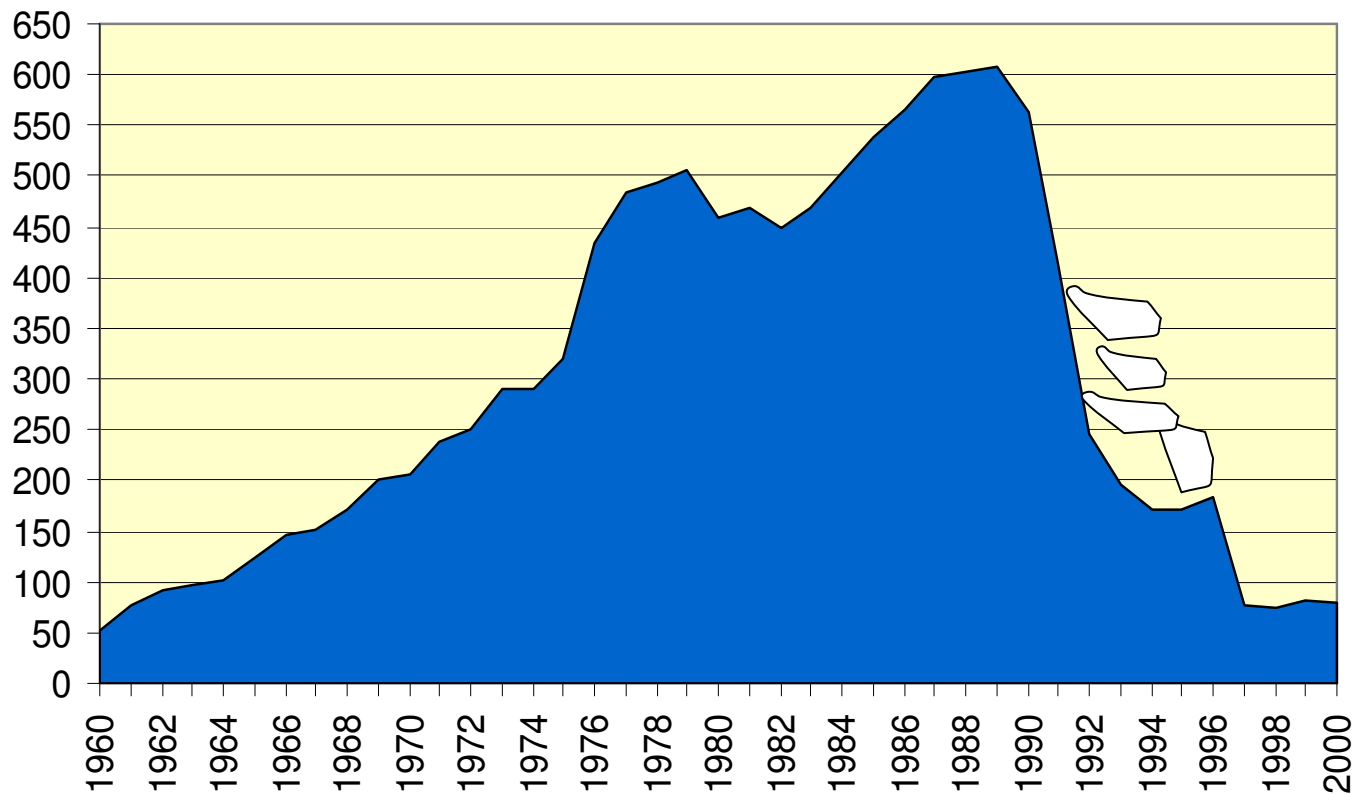


32-bit processor
Kronos from Novosibirsk;

C compiler, Unix, NUT;

own windows system
using Athena widgets.

Number of employees in the Insitute of Cybernetics and EKTA



+

People knew each other

Good beginning

Good math in high schools

Good contacts with top
researchers in the SU

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Few experts

Few contacts with the world

No advanced HW

No big/rich customers