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SOVIET COMPUTER SCIENCE, REVISITED

Edward A. Feigenbaum

Computer Science Department
Stanford University

Abstract: These few pages describe very briefly my visit to the Soviet Union in October 1964 and the impressions gained therefrom concerning the state-of-art in Soviet computer science and technology.

The sole function of these notes is to summarize a talk to be presented to the ACM National Conference in August, 1965. They do not constitute a final report on my Soviet trip.

In the summer of 1960, I visited the Soviet Union as a delegate to the International Automatic Control Congress, made an extensive tour of computer centers in the USSR, and spoke with numerous Soviet scientists in computers and cybernetics (broadly defined, in the Soviet sense). A report of this trip was published in the Communications of the ACM (1).

In October of 1964 I had the opportunity to revisit the Soviet Union under circumstances much more conducive to the free interchange of ideas and information. I was invited by the USSR Academy of Sciences to deliver a lecture series on heuristic programming and computer simulation of cognitive processes in the following cities: Moscow, Leningrad, Kiev, and Novosibirsk.

The trip lasted four weeks and, incidentally, covered the very interesting period of the Krushchev removal, the Chinese atomic explosion, and the Voschod three-man space ship. It produced a considerable amount of information, very little of which was new or startling. Most of the information serves to
corroborate previously-made inferences about Soviet capability and progress in computer science and technology. A full report will be submitted in the near future to the Communications of the ACM. To my knowledge, it is the only first-hand, detailed "reading" taken of the Soviet state-of-art in computers since the published report of my 1960 trip.

The official host institution for my 1964 lecture-visit was the Scientific Council on Cybernetics of the Academy of Sciences, a high level coordinating and steering body for the broadly defined cybernetics area. The Council's only concrete function appears to be the preparation of the irregularly produced volumes, Problems of Cybernetics. During the excellent week I spent in Kiev, the host institution was the Institute of Cybernetics (formerly the Computing Center) of the Ukrainian Academy of Sciences, headed by the brilliant Academician V. M. Glushkov. And I spent a splendid week in Siberia, at the Novosibirsk Scientific Center, as the guest of the Computer Center, its director G. I. Marchuk, and his Director of Programming, A. P. Yershov.

The trip to Novosibirsk was unique at the time. I was, evidently, the first American scientist invited to the Novosibirsk Scientific Center on an individual basis, for "working scientific discussions," to use the Russians' phrase. Previous to this only an official delegation of mathematicians had visited.

The Novosibirsk Scientific Center is a fascinating place. In six years, there has been built a "science city" of 25,000 people in a Siberian forest. Today there are fifteen fully functioning research institutes and a "science" university of 3,000 students. The Computer Center is the best
I have seen in the USSR on my two trips (in terms of the ideas that an
American computer scientist would consider sound, modern, and forward-looking).

The paragraphs that follow summarize, much too briefly, the state-of-
art in a few computer areas as I saw them in October 1964.

**Hardware.** In 1960, it could reasonably have been argued that the
Soviets would quickly close the rather large "hardware gap" that existed
then. The 1964 reading shows that they have not done so. In fact, the
gap has widened. One Soviet computer scientist remarked to me that the
USSR would not have a computer of the capability of the IBM 7090 until 1969.
The "workhorse" scientific computer is the M-20, a vacuum tube machine described
in many reports published in U.S. journals (2). Its average operation speed
is 20,000 three-address operations per second. It has a 4K memory. It has
poor input-output gear (e.g., no alphanumeric printer). It has been in
mass production since about 1960. There are less than 100 of these machines.
The only widespread transistorized machine is the MINSK-2, a small machine
with access time of 30 microseconds and add time of 250 microseconds. Other
transistorized machines, operating in the neighborhood of 50-60 thousand
operations per second are discussed (BESM-3, M-220, URAL 8). There probably
exist some advanced experimental models of relatively modern machines operating
at speeds of a few hundred thousand operations per second, though I have no
concrete evidence of this. The general state of the technology involved in
designing and fabricating big computers appears to be poor.

**Software.** Soviet work on programming languages generally lacks the
breadth and depth of American work in this field. ALGOL appears to have a
status of the standard language. ALGOL translators are now being written or
planned for virtually all machines. An excellent ALGOL system, called ALPHA,
has been developed by Dr. A. P. Yershov and his Programming Department in Novosibirsk. BETA, a non-numeric list processing type language is now under development, evidently the first major Soviet effort of this type.

Fancy monitors and control programs are not in evidence, perhaps because the computer hardware configurations are not complex enough to demand such software "apparatus" piled on.

Users groups have just received government blessing, and are now being formed for the major machines. An M-20 users group has been active for some time.

To summarize, Soviet work on software systems is not extensive, but is good to excellent where it exists (especially in Novosibirsk).

**Artificial Intelligence Research.** This is one of the "glamor" areas in Soviet writings on cybernetics, but progress appears to be minimal, lagging American work considerably. There are scattered projects in pattern recognition (mostly decision-theoretic classification theory approach), one of which has led to the building of an optical character recognition device for typewritten numeric digits (in Kiev). There is great interest, but very little work, in heuristic programming. Some work on theorem-proving, question answering machines, simulation of human cognition, and non-numeric computation is being done at the Institute of Cybernetics in Kiev. Interesting work on automation of the formation of computational algorithms is beginning in Novosibirsk.

The intensity of Soviet work in the artificial intelligence area will probably increase as computers become less scarce.
REFERENCES


3. Ware, W., and Holland, W., (eds.), Soviet Cybernetics and Technology, (a continuing series), Santa Monica, California: The RAND Corporation.