

ANNIVERSARY OF THE SCIENTIST ЮБИЛЕЙ УЧЕНОГО

On the Anniversary of Academician of the Russian Academy of Sciences and Academician of the Russian Academy of Education, Doctor of Physical and Mathematical Sciences, Professor ALEXEY LVOVICH SEMENOV

The Editorial Board of the journal “Computational Mathematics and Information Technologies” extends its heartfelt congratulations to its esteemed member, Alexey Lvovich Semenov, on the occasion of his 75th anniversary!

Alexey Lvovich Semenov is the Head of the Department of Mathematical Logic and Algorithm Theory at the Faculty of Mechanics and Mathematics, Advisor to the Rector of the Federal State Budgetary Educational Institution of Higher Education “Lomonosov Moscow State University”, Director of the A.I. Berg Institute of Cybernetics and Educational Informatics at the Federal State Institution “Federal Research Center for Computer Science and Control” of the Russian Academy of Sciences, Academician of the Russian Academy of Sciences, Academician of the Russian Academy of Education, Professor, and Doctor of Physical and Mathematical Sciences.

A.L. Semenov is an outstanding mathematician, a specialist in the fields of mathematical logic, complexity theory, and computer science. He works in the areas of artificial intelligence and the development of applied software for domestic supercomputers.

Key Milestones in the Scientific, Pedagogical, and Organizational Activities of the Jubilarian

In 1972, A.L. Semenov graduated with honors from the Faculty of Mechanics and Mathematics at Lomonosov Moscow State University, specializing in “Mathematics”. In 1975, he completed his postgraduate studies at the same faculty, defending his Candidate of Sciences dissertation titled “On Definability in Some Decidable Theories”. In 1985, he defended his Doctor of Sciences dissertation, “Logical Theories of Unary Functions on Natural Numbers”.

From 1975 to 1983, he served as a Lecturer at the Department of Mathematical Logic at Lomonosov Moscow State University. His career then continued with leadership roles, including Head of the Sector for Problem-Oriented Processors and Head of the Laboratory for Algorithm Theory and Linguistic Support within the Scientific Council of the USSR Academy of Sciences for the Complex Problem “Cybernetics” at the Institute of Cybernetics Problems of the USSR Academy of Sciences and the A.A. Dorodnitsyn Computing Center of the Russian Academy of Sciences.

From 1993 to 2013, he served as Rector of the Moscow Institute of Open Education (known until 2002 as the Moscow Institute for the Professional Development of Educators). He later served as Rector of Moscow Pedagogical State University (V.I. Lenin MPGU) from 2013 to 2016.

Since 2015, he has been the Director of the A.I. Berg Institute of Cybernetics and Educational Informatics at the Federal Research Center for Computer Science and Control of the Russian Academy of Sciences.

A.L. Semenov was elected a Corresponding Member of the Russian Academy of Sciences in 2008 and became a Full Member (Academician) of the Russian Academy of Sciences in 2011, within the Division of Mathematical Sciences. He was elected an Academician of the Russian Academy of Education in 2010. He has held the academic title of Professor since 1998.

Main Scientific Contributions of A.L. Semenov

Alexey Lvovich Semenov’s contributions to mathematics and theoretical computer science encompass results in formal grammars, program schemata and dynamic logics, relational algebras, automaton-realizable relations, and decision algorithms for a range of mathematical theories. He developed a theory of algorithmic randomness for finite sequences, parallel to Kolmogorov’s combinatorial complexity theory, and solved the Kolmogorov problem concerning the precise estimation of randomness test complexity. The central theme of his mathematical research has been definability theory, where he is a world-renowned authority.

Research on definability originates from the classical works of the Italian (G. Peano, A. Padoa, M. Pieri) and Polish (A. Tarski) schools of mathematical logic in the 19th and first half of the 20th centuries, as well as the works of K. Gödel. L. Svenonius’s key 1959 paper laid the foundation for the “Erlangen program” — the completeness theorem for definability. A.L. Semenov and S.F. Soprunov obtained a combinatorial version of the Svenonius theorem.

The decidability of the definability space for the addition of natural numbers is a classical 1929 result by Presburger. In 1979, A.L. Semenov proved the decidability of a broad class of extensions of this space by unary functions, such as exponentiation or factorial. In the case of monadic spaces, A.L. Semenov obtained results on extending the definability space for the successor of natural (or integer) numbers with almost periodic (recurrent) sequences from symbolic dynamics.

This, in particular, solved the Zykkes problem and provided a solution to Church's uniformization problem for the almost periodic case. The study of almost periodic sequences was further developed in the works of his students — A.A. Muchnik, Yu.L. Pritykin, and M.A. Ushakov. For monadic spaces, A.A. Muchnik solved a problem concerning the monadic space of several successors, posed by M.O. Rabin at the International Congress of Mathematicians in Nice. S.F. Soprunov solved the problem posed by M.O. Rabin and C. Elgot on the existence of maximal decidable definability spaces for the weak monadic case.

The general subject of definability spaces gave rise to a number of questions related to the lattice of such spaces. These questions were answered in the works of A.L. Semenov and his colleagues. In particular, examples of spaces of arbitrary width were constructed. A.L. Semenov and S.F. Soprunov constructed examples of definability spaces of arbitrary finite quantifier depth.

In 1980, A.N. Kolmogorov, who headed the Department of Mathematical Logic and Algorithm Theory at Moscow State University (the department currently chaired by A.L. Semenov), invited A.L. Semenov to co-lead a seminar on complexity, which continues to operate to this day. This defined another major direction of A.L. Semenov's work. In his seminal 1963 publication on the complexity of finite objects, A.N. Kolmogorov raised the question of the precise relationship between the complexity of a sequence, the complexity of an algorithm selecting a subsequence from it, and the degree to which the selected subsequence satisfies the law of large numbers. Kolmogorov revisited this problem in 1983. The solution to this problem by A.A. Muchnik and A.L. Semenov in 2003 was awarded the A.N. Kolmogorov Prize of the Russian Academy of Sciences as an outstanding contribution to mathematics. He is also the author of numerous works in general theory of algorithms and computations, algorithmic randomness, program logics, combinatorial group theory, computational complexity, algorithmic degrees, and effective computational algorithms.

His activity in applied computer science and the creation of artificial intelligence systems began in 1964 with participation in works on speech recognition, text generation systems, situational control, and compilers for Lisp and APL languages for domestic computers. Starting from 1983, A.L. Semenov participated in the development of applied mathematical software for the "Elektronika SSBIS" supercomputer.

A.L. Semenov is the author of the concept of the "extended personality" as a methodological foundation for AI applications in education. The "MSU Ark of Knowledge" project, implemented under his leadership, serves as the basis for building an ontology of fundamental knowledge and trusted encyclopedic systems.

A.L. Semenov participated in the creation of the "Digital Economy of the Russian Federation" program and the national strategy in the field of artificial intelligence. He is a prominent figure in Russian education and a key participant in shaping the modern content of school informatics and teacher training. His areas of interest include fundamental problems of general and pedagogical education, digital technologies in education, digital transformation of education, issues of updating the content of education in primary and secondary schools, as well as professional pedagogical education.

Beginning in 1967, A.L. Semenov taught at Moscow School No. 7, which he himself had graduated from, and later worked within A.N. Kolmogorov's team at the Physics and Mathematics Boarding School affiliated with Moscow State University. In 2003, he re-established School No. 179 as part of the Moscow Institute of Open Education (MIOO), which he headed, and brought back to work there Nikolai Nikolaevich Konstantinov, the founder and ideological leader of the tradition of specialized mathematics schools in Russia. He served as a member of the Executive Committee of the International Commission on Mathematical Instruction.

In 1984, he became the organizer and a member of the authoring team for the first informatics textbook in the USSR, published in a print run of 3 million copies for all schools across the Soviet Union.

From the mid-1980s, A.L. Semenov led developments aimed at forming a new methodology for Russian education, encompassing research activities for all students and the use of digital technologies. He developed the conceptual foundation and practical solutions (including textbooks, software, subject-specific environments, standards, and organizational documents) for learning, teaching, and management processes utilizing digital tools. He began this work under the guidance of E.P. Velikhov and A.P. Ershov within the framework of the All-Union Scientific and Technical Commission "Shkola-1" of the USSR Academy of Sciences and continued it at the Institute of New Technologies, which he founded. The methodology he created influenced the subsequent development of Russian and global education, forming the basis for UNESCO recommendations for all levels of general and teacher education.

A.L. Semenov is widely known as the founder of the Institute of New Technologies in Education (INT), which developed and adapted numerous digital educational resources for Russia, published hundreds of books for teachers on the use of ICT across all school subjects, and is recognized as a world leader in applying information technology in schools based on a constructionist approach. He led the authoring team for an integrated course in mathematics, informatics, and linguistics for primary school. Courses based on this work, "Informatics" and "Algorithmics", are now widely used in Russian schools. Under his guidance, a range of computer environments and tools for student activities were developed, aligned with modern educational goals across all subjects.

A program for regional informatization developed under A.L. Semenov's leadership received the President of the Russian Federation Prize in 1999. He is one of the leaders of joint projects involving the Russian Academy of Sciences, Moscow State University, and the educational community aimed at improving the quality of digital educational resources

and shaping standards. He was one of the developers of educational standards for schools: for Moscow in 1996, and for the Russian Federation in 2004 and 2009. He served as head of the scientific-methodological council of the Federal Institute of Pedagogical Measurements (FIPM) for the state final certification in mathematics and currently holds this position for informatics. The implementation of his ideas in the field of education in Moscow has enabled the creation of a unique, world-class information environment for learning, development, and social interaction among students, teachers, and educational management systems. Work on the informatization of Russian education carried out under his leadership was awarded the Russian Government Prize in 2009.

He served as the coordinator for the development of the Concept for the Development of Russian Mathematics Education, created in response to a May 2012 Presidential Decree, and was one of the leaders in developing the Concept for Technological Education in Schools, following an assignment from the President of the Russian Federation.

A.L. Semenov was the only plenary speaker from Russia at the II International UNESCO Congress “Education and Informatics” in Moscow in 1996, a keynote speaker at the seminar “Bridging the Gap between the Information-rich and the Information-poor: New Technologies and the Future of Education” at the 46th International Conference on Education (Geneva, 2001), and the lead author of UNESCO books “Recommendations on ICT in Primary Education” (2000), “ICT in Schools”, and “A Teacher’s Guide, or How ICT Can Create a New, Open Learning Environment” (2005). From 2019 to 2023, he led a Russian Foundation for Basic Research program on the implementation of digital technologies in schools, which involved teams from the Institute of Education as well. At his initiative, the “Charter of the School’s Digital Pathway” was adopted.

The holistic school model he built, based on the ideology of individual design of educational trajectories and the mandatory achievement of planned results by every student, is known as “result-oriented education”.

A.L. Semenov is a permanent participant in the scientific activities of the Regional Scientific Center of the Russian Academy of Education in the Northwestern Federal District, based at the Herzen State Pedagogical University of Russia and the Institute of Education at the National Research University Higher School of Economics. He has supervised the training of two Doctors of Sciences and four Candidates of Sciences. He is the author of over 400 scientific works in the fields of mathematics, computer science, and education.

Since 2021, he has served as the Editor-in-Chief of the journal *Proceedings of the Russian Academy of Sciences: Mathematics, Computer Science, Control Processes*, and from 2012 to 2018, he was the Editor-in-Chief of the journal *Kvant (Quantum)*. He is a member of the editorial boards or editorial councils of journals including *Informatics and Its Applications*, *Artificial Intelligence and Decision Making*, *Information Society*, *Bulletin of Cybernetics*, *Educational Issues (Voprosy obrazovaniya)*, *Educational Studies*, *Educational Policy*, *Pedagogy*, *Problems of Modern Education*, *Mathematics at School*, *Mathematical Enlightenment*, *Informatics and Education*, *Informatics in School*, *Computer Tools in Education*, and *Computational Mathematics and Information Technologies*.

The Editorial Board of the journal “Computational Mathematics and Information Technologies” warmly congratulates the esteemed jubilarian, wishing him robust health, new scientific discoveries, and joy from the fruits of his labor! May there be many more successful projects and grateful students ahead!

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