

The joy of doing Mathematics

Interview with Professor Ioan A. Rus

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Short Biographical Note

Professor Ioan A. Rus was born in Ianoșda village, Bihor County, Romania, on 28 August 1936. He graduated from “Babeș-Bolyai” University of Cluj-Napoca, Faculty of Mathematics, in 1960 and got his PhD in mathematics in 1968 with a thesis on the Dirichlet problem for strong elliptic systems of second order, under the supervision of Professor Emeritus

D. V. Ionescu. He held all possible teaching positions at “Babeș-Bolyai” University of Cluj-Napoca: Teaching Assistant (1960–1967); Assistant Professor (1967–1972); Associate Professor (1972–1977); Full Professor (1977–2006) and, after his retirement in 2006, Consulting Professor. The administrative positions he held were: vice-dean, Faculty of Mathematics (1973–1976); vice-rector (1976–1984 and 1992–1996); Head, Chair of Differential Equations (1985–2002); and Head, Department of Applied Mathematics (1998–2002).

Ioan A. Rus has published about 150 original works and more than ten books (monographs and textbooks), mainly in the field of *fixed point theory* and differential equations, which have more than 1300 citations. Amongst the most important monographs (co)-authored by Ioan A. Rus, we mention: *Fixed Point Theory* (Cluj Univ. Press, 2008), *Fixed Point Structure Theory* (Cluj Univ. Press, 2006), *Generalized Contractions and Applications* (Cluj Univ. Press, 2001) and *Principles and Applications of Fixed Point Theory* (in Romanian, Dacia, 1979).

He is the creator of two important research directions: the techniques of Picard and weakly Picard operators, and fixed point structures theory.

He founded and is currently the Editor-in-Chief of *Fixed Point Theory*, the first journal in the world on this topic. He has been on the editorial boards of several international journals: *Mathematica (Cluj)*; *Studia Univ. Babes-Bolyai. Mathematica*; *Carpathian J. Mathematics*; *Gazette des Mathématiciens (Paris)*; *Pure Mathematics Manuscripts (Calcutta)*; *The Global J. Math. & Math. Sciences*; *Scientiae Mathematicae Japonicae*; and *Notices from the ISMS*.

Professor Rus has received the degrees of Honorary Doctor (*Doctor Honoris Causa*) from the North University of Baia Mare and Technical University of Cluj-Napoca. He has 26 PhD students and 29 descendants.

In an attempt to explain the achievements of his impressive career, one can say that the main force in Professor Rus' life is without any doubt his enthusiasm and joy for doing mathematics and his inexhaustible intellectual and physical energy. Overall, he is a very kind, open and warm person, a pleasant conversation partner and an extremely subtle and sharp mind.

When did you decide that you would study mathematics and for what reasons?

During primary school (grades 1–4, in my birthplace village), I was a student good in all subjects, without a specific preference for any of them. During secondary school (grades 5–7, in the same location) I had a single mathematics teacher, Ion Marin Nistorescu. At the very first mathematics class, he brought with him the class catalogue, the mathematics textbook and some recent issues of the journal *Gazeta Matematică*. From the very beginning he warned us: those who aim at the maximal marks must also solve problems from *Gazeta Matematică*.

Through his particular way of teaching, he systematically cultivated our interest in mathematics, an interest which, for some of us, has turned into a passion. We liked to solve problems which seemed difficult at first glance. It was then when I first realized that, apart from material goods, humans possess a wealth to cherish: reasoning. When I graduated from secondary school, professor I. M. Nistorescu persuaded my parents to send me for further studies at the best high school in the region, the *Emanuil Gojdu* High School in Oradea, the capital city of Bihor County. The extra-curricular activities concerning mathematics were very well organized in this high school. There was a weekly *Student Mathematics Circle* and the gifted students were encouraged by their teachers to solve problems from *Gazeta Matematică*. There was also a monthly *Students Mathematics Circle*, organized at a city level by the County School Inspectorate. On top of these activities, there was the *National Mathematics Olympiad*, organized by the Ministry of Education at local, regional and national levels.

During my high school years it was the school and the activity at the *Gazeta Matematică* that mainly contributed to my training. I had no a priori plans. I enjoyed consciously attending all the mathematics activities held for students, while also fulfilling my curricular obligations. It was also during this period that I began reading mathematics books. For example, I purchased an antique version of Euclid's *The Elements*, translated into Romanian by Professor Victor Marian, and *Geometrische Untersuchungen zur Theorie der Parallellinien* by N. Lobatchevski. Among my main achievements dur-

ing my high school studies I would mention that in 1954 and 1955 I was awarded the 1st prize in the national contest for problem solvers, organized by the journal *Gazeta Matematică*, and that I finished my graduation examination paper in mathematics within 30 minutes, of the 3 hours allocated. Of the teachers that have guided me during this period I would mention Beniczky Ladislau, Ștefan Musta and Paul Tăvălug.

Please mention the key moments and facts related to your beginnings in scientific research.

From 1955 to 1960 I was a student in the mathematics faculty at “Babeș-Bolyai” University of Cluj-Napoca. I enthusiastically participated in all the curricular programs, while systematically observing the scientific life within the faculty. During this period, each department used to organize a weekly *Scientific Seminar*. I took part in the *Seminar of Analysis*, led by Professor Tiberiu Popoviciu (a member of the Romanian Academy), and the *Seminar of Differential Equations*, led by Professor Emeritus Dumitru V. Ionescu.

Within the course of differential equations, I was intrigued by Sturm’s theorem on the separation of the zeros of the solutions of a second order linear homogeneous differential equation. I gave simpler proofs to some of the generalizations of this theorem. It was in this manner that I wrote my first scientific article, which was later published.

In my third year at university, Professor D. V. Ionescu taught the course of *Partial differential equations (The equations of mathematical physics)*. This course brought to my attention the maximum principles and so I wrote my dissertation on maximum principles for parabolic equations.

Upon graduation from university (1960), I was hired as teaching assistant in D. V. Ionescu’s Chair of Differential Equations. My PhD thesis, written under his supervision, was entitled *Contributions to study of the uniqueness of the solution of the Dirichlet problem related to second order strong elliptic systems*. The doctoral evaluation committee consisted of Gh. Călugăreanu from Cluj, C. Iacob from Bucharest, both members of the Romanian Academy, and Professor Emeritus A. Haimovici from Iași.

How was the scientific scene during that period?

Within the faculty, the research activity was both intensive and highly organized. It would be enough to mention a few aspects of this organization: the weekly research seminars of the departments, the monthly conferences of the faculty (which regularly included three parts: a didactical conference, a didactical lecture and a student lecture), the contractual research activity, the research programs of the research groups, the periodic organization of national and international scientific events, and the editorial activity for two publications: *Mathematica (Cluj)* and *Studia Univ. Babeș Bolyai, Mathematica* series. Regarded from this point of view, the atmosphere was highly positive. And I was mainly interested from this point of view.

Which one of your professors was mostly influential for you? Did you have a spiritual mentor?

Among the university professors which mostly influenced my training and my formation, I would mention the mathematicians D. V. Ionescu, Gh. Călugăreanu, T. Popoviciu, Gh. Pic and C. Kalic, the physicist V. Marian, the historian C. Daicoviciu and the philosopher D. D. Roșca. Each one of these personalities had specific particularities. To answer your second question, I have to confess I have never believed in the concept of a role-model for the youngsters. The freshness brought by the youngsters within the research teams is far above any models and it is vital that leaders of research teams take this into account. The young professional has to distill the input received (from lectures, seminars, scientific events, private talks, etc.) and select what matches his/ her own skills and interests.

Did you benefit from any research periods abroad? If so, how did this influence your way of thinking, method of work and the research topics?

During the academic year 1966–1967 I pursued a specialization research at the University of Lund (Sweden), under the guidance of Jaak Peetre. Following a conference of Lars Hörmander, Professor Lars Gårding asked me, regarding the research activity at Lund University: “What do you think about this factory of mathematical production?” I have often recalled his question in the years that followed. Yes! It is beyond any doubt that a good mathematics faculty is a “factory” of mathematical production, with a number of specialists and many apprentices. From my point of view, a veritable university is one that promotes good research activity as well as didactical activity based on this research. If I were to choose between a very good teacher who has little to share and a weaker teacher with a lot to share, I would choose the latter.

During my research pursued at the University of Lund, I was supported in all matters by Professor Jaak Peetre. At that time, I was finishing my PhD thesis, which was centred on linear partial differential equations systems. J. Peetre drew my attention towards the complex problems in the nonlinear case, suggesting, among others, the works of F. E. Browder.

Back in Cluj-Napoca I contacted F. E. Browder, asking for reprints of his works. Shortly after that, I received reprints of all his works accomplished to that moment and reading them, I noticed the important role played by the fixed point theorems. So I began a systematic study of the *fixed point theory* (in algebraic structures, functional analysis, general topology, applications in the theory of equations, etc.). This time I had a clearly defined plan: to build a factory for producing fixed point principles.

And so, you also built a “factory” of mathematical production! How would you define a research team, its role and that of the team leader?

A research team is defined by the research topic, the results obtained, the common efforts to ensure a prompt and good impact of them in the mathematical literature, the level of organization and the degree to which it suc-

ceeds in being a seminary for research in a certain field. The genuine group leader is in charge of setting the quality of the thematics of research and of its results, possessing a rich mathematical culture, relevant achievements, but also important managerial skills, supporting the younger collaborators and helping them find answers to questions such as:

How to individually affirm ourselves in a group activity?
How much do we read? How much do we do research?
What is relevant in terms of mathematical innovation?
When and how to present the results of our research?
Where and how to publish a scientific paper?
Which is the right time to write and publish a first monograph?

You have initiated, coordinated and consecrated the Research Seminar “Fixed point theory and its applications”, which played an active part in the scientific life of “Babeş-Bolyai” University for more than 40 years. Could you present a few facts about this important research group?

The research seminar began in 1969 and, during the first three years, its activity consisted mainly of my lectures and the discussions generated by them. In the academic year 1969–1970, my lectures were dealing with fixed point theory in algebraic structures, published in a monograph in 1971. The theme of my lectures between 1970 and 1973 was *Fixed Point Theory in Functional Analysis*, which subsequently became a monograph under the same title. During this time, most of the participants in the seminar were final year students. From 1973 onwards, the seminar turned into a traditional research seminar.

Currently, this research group is defined through the quality of its core members: Radu Precup (*Fixed point theory for non-self operators with applications to differential and integral equations*), Adrian Petruşel (*Fixed point theory for multivalued operators with applications to differential and integral equations*), Adriana Buică (*Coincidence point theory with applications to differential and integral equations*), Marcel Adrian Şerban (*Fixed point theory for operators on product spaces with applications*), Szilard Andras (*Fixed points and integral equations*) and Veronica Ana Ilea (*Fixed points and functional differential equations*). This research group is also editing the journal *Fixed Point Theory* and periodically organizes the series *International Conference of Nonlinear Operators and Differential Equations (ICNODEA)*.

Tell us how FPT has been founded as a periodical publication associated to the group’s activity.

Our first publication directly associated to the research seminar was *Seminar on Fixed Point Theory – Preprint no. 3* (1980–1999), followed by *Seminar on Fixed Point Theory Cluj-Napoca* (2000–2002) and finally, from 2003 onwards, by the present journal, *Fixed Point Theory*, an ISI journal since 2007.

During an impressive career, you have harmoniously blended research and didactical activities, as well as

administrative work. How did you manage to balance them all? Please detail as much as possible.

There is nothing special in the statement implied by your question. The activity of a university professor is always threefold: research, teaching and services towards the academic community. In all these three areas, I have constantly selected the essence, seeking to solve problems and not get dragged into bureaucratic activities. It is crucial to consider these components as a whole. For instance, in my teaching activity, I have often used the heuristic approach. I was pursuing a mathematical activity that led to a theorem. The proof was always above the theorem and not following it, as in any heuristic reasoning. In teaching mathematics, it is important to illustrate, as much as time allows it, the path towards the mathematical result. This is the natural milieu for attracting students to mathematical research. Universities should promote research activity and efficient didactical activity based on this research.

Imagine you are a young mathematician today. What opportunities or disadvantages could you define in our days, compared to the conditions you had in the 60s?

In my days, to have access to recent information was extremely difficult. The budget allocated for the mathematics library was insufficient to provide a minimum research basis. But we did not fall into the trap set by the budget myth. On the university level, a collective of professionals was in charge of solving this very hard problem. I was also part of this team, which was led by professor Gh. Pic. We strived to obtain as many journals as possible, by means of an exchange program with the publications of our faculty: *Mathematica* and *Studia*. It was the quality of our publications and the professors’ common effort which ensured a solution to the documentation problem. The Romanian mathematicians working abroad were of great help as well. Before 1989, it was also a common procedure to request reprints of papers from their own authors.

Today the access to information is almost complete. Through the financial effort of our university, for example, one can access the most important databases as well as the relevant mathematical journals. We can obtain reference books through our library and through the research grants we are running. Therefore, today, a young Romanian mathematician who possesses the will and the intellectual capacity is able to obtain competitive accomplishments in research.

Could you mention a few of the major mathematical problems you have been interested in?

I would mention two such problems. The first one goes as follows:

Let us consider an operational equation on a set endowed with a convergence structure (metric space, topological space, L -space). Assume that all the solutions of the equation are obtained by successive approximations. Which are the properties of the solutions of such an equation? In order to solve this problem, I have constructed the theory of weakly Picard operators, which has proved



Professor Ioan A. Rus (left) in 2004 as a Honorary Doctor of North University of Baia Mare together with Acad. Petar Kenderov (right) and Vasile Berinde

to be extremely useful in the case of other mathematical problems as well.

Another problem I would like to discuss is dealing with invariant sets:

We have a fixed point theorem T and an operator f , which does not satisfy the conditions of T . Under which conditions does the operator f have an invariant subset Y such that the restriction of f to Y , $f|_Y$, satisfies the conditions of T ? In order to rigorously formulate this problem, I have introduced the notion of *fixed point structure* on a set and I have solved the problem by constructing the *theory of fixed point structures*.

Which are, in your opinion, the main trends and challenges in this field of research?

A great number of results have been obtained in the field of fixed point theory. I would assume the main issue is to direct these abstract research results towards solving the great problems (constantly open!) of: functional equations, ordinary differential equations, functional-differential equations, differential and integral inclusions, set-differential equations, etc.

What role do you think the history of mathematics plays within mathematical education?

The elements of the history of mathematics often represent a natural path towards mathematical understanding. Observing the evolution of mathematical objects is a key component in teaching mathematics.

You have been constantly involved in promoting mathematical education in Romania. Can you tell us a few words about the current position mathematics holds within Romanian education?

There are a number of factors contributing to the quality and efficiency of an education system but mostly it is the quality of the teachers and the atmosphere created within the school population by the managers that define the attributes. This is how one could explain the quality of the Romanian education system, both before and after 1989.

You have devoted many years and much energy to administrative works, including your membership in the evaluation committees at the Ministry of Education. What do you think about the criteria used in evaluating mathematicians from universities and research institutes? Is there a flawless evaluation grid? What should be, in your opinion, the essential requirements?

Unfortunately, the criteria currently applied in the evaluation of mathematicians are somehow implicit and are based on a kind of arithmetic of research activities: the *number* of ISI papers, the *number* of papers processed in a certain database, the *number* of books, etc. In my opinion, any evaluation system for research activities should be based on principles such as: 1) A clear statement about the aim of the evaluation (keeping the current position, promotion, contest, financing, etc.); 2) A self-evaluation following a flexible, a-priori defined structure; 3) The evaluation of five papers selected by the evaluated mathematician, by a committee of experts in the field outside the home institution of the candidate; 4) Establishing a minimum period T of years for which the evaluation is done ($T \geq 3$ years!).

Generally speaking, excellence cannot be evidenced through an arithmetical evaluation. A genuine evaluation system cannot be applied by a bureaucrat but by highly trained specialists.

In the evaluation of the efficiency of an education system, it is not the results that should prevail but mostly the progress recorded by the students. It is one thing for a student used to getting a 4 mark to achieve a 6, and another thing completely for a 10 mark student to become an 8 mark student (on a scale 1–10). To sum up, I am personally optimistic regarding the future of Romanian mathematical education and research.



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Vasile Berinde is a professor of mathematics and Director of the Department of Mathematics and Computer Science at the North University of Baia Mare. He is the first PhD student of Professor Ioan A. Rus. He is an Associate Editor of the EMS Newsletter and also the Publicity Officer of the EMS.