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A BRIEF HISTORY OF MATHEMATICAL LOGIC AT THE FACULTY OF SCIENCE IN KRAGUJEVAC

ABSTRACT. The paper presents a brief historical overview of education and research in the area of Mathematical Logic and its applications at the Faculty of Science in Kragujevac.

1. Introduction

In October 1972, the Faculty of Science at University of Belgrade issued a decision on the establishment of the Department in Kragujevac, in which two groups have been established: the Group of Mathematics and Biology Group. The department started on October 23 in 1972/73 school year. In March 1976, the procedure for the separation and independence from the Faculty of Science in Belgrade was undertaken. Since all conditions for the formation of an independent Faculty were fulfilled, the Parliament of the Republic of Serbia approved the independence of the Department in Kragujevac and decided on the establishment of the Faculty of Science in Kragujevac¹. Today, in Kragujevac, Faculty of Science consists of four institutes: the Institute of Biology and Ecology, Institute of Physics, Institute of Chemistry, Institute of Mathematics and Informatics.

2. Education at the Faculty of Science

Lectures on mathematical logic at the Faculty of Science in Kragujevac began in 1972, when the Department was opened. Since then, mathematical logic is a part of the curriculum in the study group Mathematics in two courses: the first one is a basic course of mathematical logic with the elements of set theory and the second one is advanced course of Algebra and logic which is intended for senior students of mathematics.

¹The University of Kragujevac was founded on May 21, 1976. This is actually the date when Prince Miloš Obrenović, back in 1838, set up “Licej” the first institution of high education in Serbia. When Belgrade became the capital, most of the ministries moved there along with “Licej”. In 1863 it was renamed into “The Great School” and in 1905 it eventually became the University of Belgrade. At the beginning of its work the University of Kragujevac incorporated five faculties: Faculty of Mechanical Engineering, Faculty of Economics, Faculty of Law, Faculty of Science and Mathematics and Technical Faculty in Čačak and two research institutes: Small Grains Research Institute in Kragujevac and Fruit Research Insitute in Čačak.

From 1972 to 1981 the lectures on mathematical logic were held by Professor Đuro Kurepa (1907–1993)² and Miodrag Mišić³. Later, Algebra and logic was held by Žarko Mijajlović (1948–) and Zoran Marković (1948–). In these early years of the Department of Mathematics in Kragujevac, they used to travel from Belgrade to give lectures supporting in this way the development of the Department.

Soon after the establishment of the Department of Mathematics in Kragujevac, Miodrag Rašković (1951–) and Dragić Banković (1947–) were hired full time as assistants, the former in 1976 and the latter in 1978. At that time, they were graduate students of mathematics at the Faculty of Science and Mathematics in Belgrade, and their major was mathematical logic. In the last three decades, they have significantly contributed to the development of mathematical logic at the Department of Mathematics in Kragujevac .

From 1981 to 2009 professor Dragić Banković gave lectures on Mathematical Logic with Set Theory. For several years, in the early nineties, Aleksandar Jovanović (1949–) was professor there, too. He was lecturing Mathematical Logic and Discrete Mathematics.

Since 2009, the lectures on Mathematical Logic with Set Theory have been held by professor Radosav Djordjević (1961–).

After professor Zoran Marković, the lectures on Algebra and logic were held by professor Miodrag Rašković from 1983 to 2003 when he moved to the Faculty of Education in Belgrade. Nebojša Ikodinović taught Algebra and logic from 2003 to 2009 when he moved to the Faculty of Mathematics in Belgrade. Now, Radosav Djordjević gives lectures on Algebra and Logic.

A great influence on the development of mathematical logic in Kragujevac had Professor Slaviša Prešić (1933–2008) who was born in Kragujevac. Although Professor Prešić spent his working life at the University of Belgrade, he often pointed to his hometown and proudly spoke of Kragujevac. In Serbia a large number of mathematicians have been studying and developing Prešić's results in their research papers, books, MSc and PhD theses.



In the late eighties, when the Department of Informatics started its intensive development, the help of Professor Prešić was necessary and he gave lectures for the courses in programming languages LISP, PROLOG and C.

According to the latest curriculum of informatics at the Faculty of Science in Kragujevac, mathematical logic and its applications in computer science are contained in two

²Professor Djuro Kurepa belongs to the narrow circle of the most known and most significant Serbian mathematician. His main contribution was in Set Theory and General Topology.

³The basic research field of Miodrag Mišić is General Topology.

subjects: Theoretical foundations of informatics I and Theoretical Computer Science. Theoretical foundations of informatics I is held by Silvana Marinković and Theoretical Computer Science by Nebojša Ikodinović. Zoran Ognjanović taught Theoretical Computer Science in Kragujevac for several years and made a great influence on today's curriculum of these subjects. The book [2] is based on his lectures in Kragujevac.

Last but not least, there were many of those who conducted the tutorials in mathematical logic and related subjects. Some of them, not mentioned before, are Aleksandar Ignjatović⁴, Željko Pavlović, Tatjana Stojanović, Suzana Simić, Tatjana Aleksić, Nenad Stojanović, etc. The author apologizes in advance for any omission but it was not possible to create an exhaustive list of all assistants who have participated in the teaching process of mathematical logic.

3. Research at the Faculty of Science

As mentioned in the previous section, Professors Banković and Rašković determined the areas of research in mathematical logic by which the Department of Mathematics in Kragujevac is recognized.

Dragić Banković received his PhD in 1980 at the University of Belgrade, under supervision of Professor Slaviša Prešić. In 1987, he was in Frankfurt at Institut für Informatik, and in 1988, in Berkeley at the Department of Mathematics of the University of California. The main research interest of Banković includes general equations, Boolean algebras, Multiple-valued logic and Post algebras. He published over 80 papers in Mathematics, Medicine, Biology and Chemistry, including 37 papers from Thompson's list. The mathematical papers of Dragić Banković have been published in Discrete Mathematics, Discrete Applied Mathematics, Multiple Valued Logic and Soft Computing, Fuzzy Sets and Systems, Bulletin de la Societe Math. de Belgique, Publ. Inst. Math. Beograd, Acta Mathematica Sinica.

The papers of D. Banković were cited in international journals and monographs. Particularly, Banković has been the most cited author (27 cited papers) in S. Rudeanu's monograph "Lattice functions and Equations" (Springer, 2001).

Miodrag Rašković received his PhD from the Faculty of Science in Belgrade with the thesis of *Logics with measure in Leibniz's universe*. In 1980, he spent four months at the Warsaw University as a scholar of Polish Government, and in 1986, three months at the University of Wisconsin in Madison. Miodrag Rašković is actively engaged in scientific research in the field of model theory, nonstandard analysis, theory of measure, non-classical logic, cylindric algebras, artificial intelligence and so on. He has results in more than 100 scientific papers in journals of national and international importance, some of which are quoted in a world recognized and popular monographs in various areas of mathematics. He participated at about 50 local and international conferences and scientific meetings. The papers of Rašković have been cited in well known international monographs, e.g. "Model Theoretical Logic" (Ed. J. Barwise, S. Feferman, Springer Verlag) and "Nonstandard Analysis and its Application" (Nigel Cutland, Cambridge University Press).

Miodrag Rašković is a recognized authority on probabilistic logic. He introduced a new method of using the Barwise compactness theorem in proving completeness theorems. By applying this method Rašković solved several well-known open problems and particularly, he proposed the solution for Keisler's known problems related to the theorem for biprobabilistic logic. Miodrag Rašković and Radosav Djordjević are the authors of the

⁴In 1990, Aleksandar Ignjatović was received his Ph.D. in mathematical logic at the University of California at Berkeley.

monograph in English *Probability Quantifiers and Operators* (Vesta Company and Math. Institute SANU, Belgrade), which was quoted by world-renowned experts in the field of probabilistic logic (e.g., Petr Hájek, “Metamathematics of Fuzzy Logic”, Trends in Logic, Studia Logica Library, Kluwer Academic Publishers, 2001, and Sergio Fajardo, H. Jerome Keisler, “Model theory of stochastic processes”, Association for Symbolic Logic, 2002).

Philosophy and history of mathematics are also areas of interest of Miodrag Rašković. As part of this work, he has published many papers and delivered many lectures. Especially prominent is the original approach in studying the concept of infinity in mathematics which is partly based on Vopenka’s Alternative Set Theory. These considerations have raised considerable interest among Czech logicians.

Miodrag Rašković formed a large group of researchers, first in Kragujevac, and then in Belgrade, who work in mathematical logic, especially in the field of probabilistic logic. While working with this group he was the supervisor of two doctoral dissertations (Radosav Djordjević and Zoran Ognjanović) and four master’s theses (Predrag Tanović, Milanka Bradić, Silvana Marinković and Nebojša Ikodinović).

Radosav Djordjević enrolled in 1983 in a Masters of Science in Belgrade in the field of algebraic and combinatorial topology. In 1986 he defended his master’s thesis *One parallel between some homological and combinatorial techniques* under the supervision of Prof. Marjanović. Then Djordjević became interested in mathematical logic and in 1990 he was in Madison at the University of Wisconsin (USA). He received his PhD in 1991 with the thesis *Probability logic* under the supervision of Miodrag Rašković. In a series of papers Radosav Djordjević investigated probabilistic logic with integrals and conditional expectations.

Zoran Ognjanović received his PhD at the Faculty of Science in Kragujevac under the supervision of Miodrag Rašković. His doctoral dissertation entitled *Some probability logics and their applications in computer sciences* has become a very useful reading for all young researchers to be included in a group led by Miodrag Rašković.

Nebojša Ikodinović received his PhD at the Faculty of Science in Kragujevac with the thesis of *Some Probability and Topological Logics* under the supervision of Radosav Djordjević.

As students of Professor Rašković, R. Đorđević, Z. Ognjanović and N. Ikodinović have published many papers in national and international journals, further developing their professor’s investigations and applying methods he had introduced.

Silvana Marinković received PhD at the Faculty of Science in Kragujevac with the thesis of *Equations on some lattices* under the supervision of Dragić Banković. The research interest of Silvana Marinković is Multiple-valued logic, Boolean algebra, Post’s algebra and Stone’s algebra. The papers of S. Marinković have been published in Multiple Valued Logic and Soft Computing, Publ. Inst. Math. Beograd, Information Sciences and Facta Universitatis (Series Mathematics and Informatics).

4. Conclusions

As it can be seen from the previous section, a great number of papers in mathematical logic have come from the Department of Mathematics in Kragujevac. Today, at the Department of Mathematics, there are several students enrolled at doctoral study program in mathematical logic. They are Tatjana Stojanović (assistant at the Faculty of Science in Kragujevac), Vladimir Ristić (assistant at the Faculty of Education in Jagodina), Nenad

Stojanović (research assistant at the Faculty of Science in Kragujevac) and Ljubica Muđrić. Those young and prospective mathematicians are supposed to continue the existing broad research in mathematical logic and contribute to its further development.

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1.1 Mathematical Logic: a brief overview.

Aristotle identified some simple patterns in human reasoning, and Leibniz dreamt of reducing reasoning to calculation. As a viable mathematical subject, however, logic is relatively recent: the 19th century pioneers were Bolzano, Boole, Cantor, Dedekind, Frege, Peano, C.S. Peirce, and E. Schröder. Mathematical logic has now taken on a life of its own, and also thrives on many interactions with other areas of mathematics and computer science. In the second half of the last century, logic as pursued by mathematicians gradually branched into four main areas: model theory, computability theory (or recursion theory), set theory, and proof theory. The history of logic is the study of the development of the science of valid inference (logic). Many cultures have employed intricate systems of reasoning, and logical methods are evident in all human thought. An explicit analysis of the principles of reasoning was initially developed in three traditions: Indian logic, Chinese logic, and Greek philosophy. Of these three, only the Greek and Indian traditions had survived into early modern times. Logic was known as dialectic or analytic in ancient A Brief History. Department of Mathematical Sciences. A Brief History. The Department of Mathematical Sciences at the Norwegian University of Science and Technology (NTNU) of today has its origin in the chair of mathematics at the Norwegian Institute of Technology (NTH), established at the foundation of the institution in 1910. Richard Birkeland. The first person to hold this chair was Richard Birkeland. The faculty expanded as the activities increased, and before the merger in 1997 it consisted of about 12 persons in permanent scientific positions. Henrik H. Martens. In 1968 Henrik H. Martens began his work as professor at NTH.