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Report on implementation of the new programs

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Abstract	This report is the Report on implementation of ADA master study programs at three universities in Serbia: University of Novi Sad, University of Belgrade and University of Niš.

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Table of Contents

UNIVERSITY OF BELGRADE

The master study program *Advanced Data Analytics (ADA)* implemented at the University of Belgrade (UB) is detailed at its Website. It is a 90 ECTS study program, developed primarily for students who have already completed their BSc studies in a quantitative discipline, but is also open for students with backgrounds in other disciplines.

The development of the ADA study program at UB has been jeopardized by many factors, throughout the project duration. These factors are not related only to the Covid-19 pandemic. Most of these factors have been of administrative nature – the change of the UB administration, the lack of administrative staff, the delays caused by very rigid limitations of the accreditation procedure, as well as the discord between the ADA project team from UB and part of the UB managerial and administration structures. It was only with the persistency and enormous efforts of the ADA project team from UB that the study program has been finally put to life and the first generation of students has enrolled. The classes for this first generation have started in this academic year. The informal procedure of tracking the class activities indicates a continuous attendance by the majority of students, as well as intensive out-of-class communication between the students and the teachers.

It is perceived by the ADA study program management that the key to success of the program so far has been timely start of each and every activity (contacts with the students, announcements, pre-class communication, all study materials available before the classes have even started, detailed explanations provided to students at any point, etc.

The ADA study program implemented at UB has taken into account the latest developments and state-of-the art technologies in data analytics, data science, applied statistics and related fields. The program focus is on data analytics in life sciences and social sciences, with several courses also covering natural sciences.

More specifically, due to the fact that the ADA study program at UB is designed for students with different backgrounds, the program has in its offer several courses related to mathematical foundations of data analytics, as well as several courses related to computer science and computing tools used in data analytics. In addition, several courses cover application of data analytics in different domains. Many of the courses offered present their topics putting them also in the context of collaboration and communication skills, legal regulations, and ethical norms.

There are no required courses in this study program – the students can choose among a number of different elective courses according to their preferences, in order to earn the total of 90 ECTS. The only restriction is that they have to pass 3 (out of 6) exams in quantitatively oriented foundational courses (selected topics in mathematics, statistics, etc.), 3 (out of 9) exams in

technology-oriented courses (programming, databases, artificial intelligence,…) and 2 (out of 8) application-oriented exams (in application areas of their choice).

Students who have completed the ADA master program at UB become competent in:

- independent work in analyzing datasets of different complexity in selected domains, with advanced use of current data analysis tools and technologies
- preparing, modifying, adapting and combining datasets for analysis, out of raw data produced from different applications and other sources
- involvement in various interdisciplinary working teams where data analysis skills in different disciplines and mastery of current data analysis tools and technologies are expected, not only in solving routine practical problems, but also in non-standard situations where creativity and research approach are required working with large sets of data.

The ADA study program implemented at UB includes all modern forms of working with the students: lectures, practical work in laboratories, case studies, teamwork, research projects, group and individual professional visits, visits of prominent experts, eLearning (with appropriate software and organizational support), creative workshops, debates, discussions through forums and other electronic services, professional practice, and internship.

The ADA project team puts high priority on students' professional practice and internship. These are designed for preparing the students for independent research and professional work in identifying and solving specific problems related to the fields studied in the ADA program (in real-life contexts, such as workplace and/or research laboratories and centers). Even during the classes, the students are required to work on practical assignments coming from the real-world data, with only a minor guidance from the teachers. This has been already proven to be motivating for the students, since they don't want to work only on toy-problems coming from the world of academia and theory.

More specifically, the students are required to work on project tasks and activities related to problems coming directly from different application domains, where software technology is applied to conduct the work. They are also required to define research tasks and objectives themselves, with as little guidance from the teachers as possible. They are expected to master basic methods, techniques, and tools for practical project implementation – selection of appropriate computing methods related to the project objectives and/or predicted empirical research. In the end of their studies, they are expected to have a good command of different elements of presenting the results achieved and/or research conducted, using collaborative

Internet tools, electronic portfolio presentation, advanced visualization and reporting, and the like.

UNIVERSITY OF NOVI SAD

The master study program *ADA in Business* implemented at the UNS is detailed at the project website and separate website at HEI (https://www.ef.uns.ac.rs/ofakultetu/studijski-programi/mas-advanced-data-analytics-in-business.php). After consultations with EACEA and NEO Serbia, we have expanded the program and made the master with 120 ECTS, lasting two years, instead of previous proposal of 90 ECTS and one and a half year, in order to provide easier enrolment of international students. We have introduced additional courses and increased the number of hours and ECTS for already existing courses. The program is accredited and the classes for the first generation have started in 2022.

The ADA study program implemented at University of Novi Sad has taken into account the latest developments and state-of-the art technologies in data analytics, data science, applied statistics and related fields.

More specifically, because the ADA study program is designed for students with different backgrounds, the programs have in its offer several courses related to mathematical foundations of data analytics, as well as several courses related to computer science and computing tools used in data analytics. In addition, several courses cover application of data analytics in different domains. Many of the courses offered present their topics putting them also in the context of collaboration and communication skills, legal regulations, and ethical norms.

Students who have completed the ADA master programs become competent in:

- independent work in analysing datasets of different complexity in selected domains, with advanced use of current data analysis tools and technologies
- preparing, modifying, adapting and combining datasets for analysis, out of raw data produced from different applications and other sources
- involvement in various interdisciplinary working teams where data analysis skills in different disciplines and mastery of current data analysis tools and technologies are expected, not only in solving routine practical problems, but also in non-standard situations where creativity and research approach are required
- Implementation of security measures and ethical practices for the collection and storage of data
- Communication and summarizing results of data analysis in written, oral and visual form.

At UNS, the program focus on business analytics, with total of 120 ECTS. There are eight compulsory courses (75 hours each), and the basket with ten elective courses (60 hours each), where student must choose five of them. All the courses have the value of 7 ECTS, internship in the company is 4 ECTS, and final paper is 18 ECTS. There is also an introductory course for the students willing to improve their basic knowledge in IT, before they start with the study program.

UNIVERSITY OF NIŠ

The Master course Advanced Data Analytics in Business (ADA in Business) that is implemented at the Faculty of Economics University of Niš is a well-balanced theory and application-based program that will provide students with a broad education in advanced statistics, digital data acquisition, digital data management, data analysis, and data presentation i.e. visualisation. In addition to a strong theoretical basis, which will be led by highly qualified teachers from the country and abroad, the implemented concept of the master's program implies strong cooperation with business entities, and practical work of students during the preparation of master's theses.

The implementation activities encompass the framework for successful and sustainable cultivation of the knowledge and practical skills in order to collect, classify, analyse, and model data at large scales and across domains using statistics, econometrics, machine learning, and software engineering with this online data analytics master's degree program. The teaching process is a combination of theoretical and practical classes, which is conducted in a state-of-the-art classroom equipped with a workstation for storing and analysing large data, as well as computers for each student. In addition to the classes that will take place live, students will have the opportunity to follow them in a recorded format online. Furthermore, in cooperation of Faculty of Economics Niš with the Budin soft company, a customized mobile application ADA FEUN was developed as a specific Learning Key product, which will support teaching process and make teaching materials as well as student-professor communication channels available in the form of a mobile application.

ADA in Business at the Faculty of Economics, University of Niš is a master's program that is accredited for delivery both in Serbian and in English. The duration of the master's program is four semesters and brings a total of 120 ECTS. The developed curriculum includes a total number of twelve courses that students take, six of which are compulsory, while the other six are optional with the possibility of choosing from a total of twelve electives. The programming languages that students master during the master's course are Python and R, as well as a whole range of software packages for data analysis, visualization and optimization. ADA in Business is strongly grounded in its application in finance, and students will acquire relevant knowledge in the areas

of time series analysis, econometrics and quantitative finance. In addition, the curriculum contains a number of subjects that are quantitative support and analysis for decision-making and business management, as well as courses that complement knowledge in machine learning, big data analysis and databases managed.

Students who complete the program will be able to: (1) Organize, manipulate, and summarize data in various formats; (2) Convert a data analytic problem and related information into a proper mathematical representation and select appropriate methodologies for analysis based on attributes of the available data sets; (3) Implement security measures and ethical practices for the collection and storage of data; (4) Transfer (and transform) data from different platforms into usable contexts; (5) Communicate and summarize results of data analysis in written, oral and visual form; and (6) Select the appropriate methods and tools for data analysis in specific organizational contexts; and (7) Plan and produce an in-depth research project, using programming languages such as Python and R, or visualisation and analytics' tools like Power BI and Tableau.