R E V I E W

on the application of Dr. Kristina Ivanova Dineva for a competition of appointment
at the academic position of "Associate Professor" in the professional field
4.6. Informatics and Computer Sciences, specialty Informatics

by Prof. DrSc Galia Angelova, IICT-BAS

By order No. 9/10.01.2025 of the Director of the Institute of Information and Communication Technologies, Bulgarian Academy of Sciences (IICT-BAS), I have been appointed as a member of the Scientific Jury in a competition for the academic position of "Associate Professor" in professional field 4.6. Informatics and Computer Sciences, specialty Informatics. The competition was announced in the "State Gazette" No. 97/15.11.2024 for the needs of IICT-BAS, section "Modeling and Optimization". The only candidate in the procedure is Dr. Kristina Ivanova Dineva.

According to the *Regulations for holding academic positions at IICT-BAS* regarding the fulfillment of the minimum selection requirements, the candidates for the academic position "Associate Professor" at IICT in the field 4.6 Informatics and Computer Sciences must have at least 50 points on indicator A, 100 points on indicator B, 260 points on indicator Г, 70 points on indicator Д and 20 points on indicator E. The candidate Dr. Dineva presents a completed report on the fulfillment of the minimum national criteria of NACID and, in addition, a report on the fulfillment of the minimum requirements of the IICT regulations, which contains 50 points under indicator A, 140 points under indicator B (from three publications with a relatively high impact factor in WoS, respectively 3.9/Q2, 3.2/Q1 and 2.5/Q1, printed in 2021-2024), 286 points under indicator Г from 14 publications, 288 points under citations under indicator Д and 70 points under indicator E.

Regarding the requirement to apply in the competition with scientific works that have not been submitted in previous procedures, 10 of the 14 publications presented under indicator Г were published in the years 2021-2025, so they were not presented in previous procedures. The full text of the candidate's doctoral dissertation was submitted in mid-2020 and is available on the IICT website /https://iict.bas.bg/konkursi/2020/KrDineva/dissertation.pdf, see page 145/. We notice that the papers Г-1, Г-3, Г-4 and Г-6 published correspondingly in 2020, 2020, 2020 and 2018 present no results, included in the doctoral thesis of Kristina Dineva (the latter refers only to papers published before 2020). In the list of 48 citations of two publications by Dr. Dineva, presented in connection with indicator Д, there is a large number of citations from independent sources with authors from abroad, and the citations are made in papers published in serious volumes with impact factor or/and Scopus rank. The points under indicator E were collected from 5 participations in projects of the institute, and Dr. Dineva was the leader of a project under the national programme "Young Scientists and Postdoctoral Fellows-2".

Dr Dineva has 5 years of work experience at IICT-BAS in the specialty (of which over 3 years as a senior assistant), as well as a diploma from BAS from January 2021 for the awarded educational and scientific degree "Doctor" in Informatics. The formal requirements of the Regulations for holding academic positions at IICT-BAS are not only met, but also exceeded, especially in the quantities under indicators Г and Д.

Brief information from the scientific biography of Dr. Kristina Dineva

The candidate graduated from secondary education at the Commercial High School in Stara Zagora in 2010. In the period 2010-2014 she followed a bachelor's program in Industrial Economics at the University of Economics in Varna, during which she attended Roma Tre University with Erasmus mobility in the period 2013-2014 and attended courses in Business Economics. She received a master's degree in Informatics from the New Bulgarian University in 2016 and became a full-time doctoral student at the IICT-BAS for the period 2017-2020. In parallel with her studies for higher education, she held positions as a programmer in the software industry. Her CV lists computer skills and competencies of a professional software developer.

General description of the publications submitted for the procedure

17 scientific articles, published mainly in the last 4-5 years, were submitted for the competition (5 are publications indexed by Web of Science and 4 of them have WoS impact factor; the remaining 12 are indexed in Scopus, 9 of which have an SJR rank). All publications are co-authored with Bulgarian colleagues. The list of citations submitted for participation in the competition contains 258 citations of 22 of Dr. Dineva's articles. A check in Scopus shows that 26 publications of the candidate are indexed in Scopus, with 200 citations found in 177 articles authored by an international circle of scientists, and an H-factor of 8 for Dr. Dineva. The latter means that although Kristina publishes with Bulgarian co-authors, her publications in international Proceedings and Volumes are recognisable and foreign experts use them as a useful reference and source of information.

The topics of the presented works fall into the areas of: *(i)* Cloud technologies and infrastructures; *(ii)* Information systems architectures and Internet of Things (IoT) technologies; and *(iii)* Machine learning and artificial intelligence. Dr. Dineva's results can be characterised as scientific and applied science.

Scientific and applied contributions described in the presented materials

The results obtained in the topic "Cloud technologies and infrastructures" are related to the participation of Dr. Dineva in the creation of prototypes for smart livestock farming. A holistic approach to smart agriculture is adopted by combining IoT technologies, cloud computing and machine learning. The goal of the developments is to improve the productivity and efficiency of computational processes by developing modern infrastructures based on cloud technologies, integrated IoT devices, machine learning and digital twins. This makes it possible to create reliable solutions for managing and processing large data sets, real-time visualisation and effective process optimisation, as well as ensuring accessibility, security and scalability. In addition, cloud technologies are seen as a transition to sustainable and energy-efficient solutions that significantly reduce the carbon footprint and energy costs. An intelligent monitoring system in livestock farming is proposed, which integrates IoT devices and cloud services for the purpose of collecting, processing and visualising data in real time. The developed cloud architecture includes an original approach to process organisation that facilitates animal monitoring, yield prediction, and environmental monitoring. The prototype was tested in the context of smart agriculture and was shown to contribute to reducing human resources, optimising costs, and modernising the livestock farming process. The system's capacity to

process large volumes of data from multiple IoT sources was demonstrated. Critical points of the architecture were tested to confirm its reliability. Integrated machine learning functionalities achieve high accuracy of analyses and forecasts, making the architecture suitable for implementation in real farm conditions. The concept of cloud-based digital twins was also introduced as a tool for simulation, control, and optimisation of processes in smart agriculture. Digital twins provide synchronisation between physical objects and their virtual representations, which allows for forecasting key events and improving operational efficiency, as well as providing simulations and additional optimisation. The technology significantly reduces the resources required for data storage. The overall focus of Dr. Dineva's research in this area is on modernisation, sustainability and energy efficiency in the development of intelligent systems for monitoring agricultural activities. Three of the candidate's publications with a high number of international citations are in this area.

The results related to the topic "Information Systems Architectures and the Internet of Things" are aimed at solving problems arising from the integration of IoT devices for collecting and processing heterogeneous data, as well as creating effective architectures for building information systems. These results are presented in 6 publications. Particular attention is paid to the ways of working with heterogeneous data, the resilience of systems in the presence of large volumes of data, and the application of original solutions to create multi-sensor platforms and cyber-physical systems for the needs of smart agriculture. Methods for secure and reliable data collection are applied. The subject area for testing prototypes, which combine theoretical principles of modern architectural design and practical approaches for implementing sustainable and scalable IoT solutions, is smart agriculture. An important task is to find solutions for real-time data management with monitoring of parameters for measuring and assessing air quality in closed farms. Architectures for developing IoT-multisensor environments using inexpensive sensors and open source software are proposed, which makes the proposed solution accessible to a wide range of farmers, regardless of the scale of their farms. The main idea is to use easy-to-install and maintain devices that provide detailed information about environmental conditions and support informed decision-making for managing farm operations. The systems provide real-time data collection, while reducing costs and increasing the accessibility of innovative technologies in the livestock sector. An IoT architecture built on a microservice principle, in which machine learning is integrated, is presented. This architecture guarantees atomicity of services, i.e. each service operates separately and independently, which greatly facilitates the integration of the devices under consideration into the general IoT ecosystem. Another publication describes a system that collects heterogeneous data from various sensors and communication modules, enabling modeling of processes and phenomena in intelligent livestock farming. Thus, the effective use of IoT architecture to improve the management and optimisation of complex processes in real time is demonstrated. A scalable IoT architecture integrating artificial intelligence is also proposed, which provides centralised management of multiple remote devices through cloud computing. In summary, in this group of results, innovative technologies for effective data management, monitoring and simulation are linked to IoT architectures of cyber-physical systems and multi-sensor platforms, which provide process optimisation, efficiency increase and improved management.

Dr. Dineva's achievements related to the field of "Machine learning and artificial intelligence" are presented in 8 publications with scientific and applied results aimed at creating models for classification, regression, clustering, detection of deviations and anomalies,

recognition of actions and providing recommendations. The theoretical foundations and practical implementation of various machine learning algorithms and appropriate application areas are studied. The processes of data preparation, data cleaning and normalisation, as well as methods for testing and validating the results are considered. Optimisation techniques are applied that improve the accuracy and performance of the algorithms and adapt them to the specific requirements of various practical applications. A systematic review of various machine learning algorithms and scenarios for their combination as an approach to improving the accuracy and efficiency of the models is presented. For example, a model for classifying the health status of dairy cows based on data collected from IoT devices and environmental factors is presented. The analysis workflow includes systematic data processing, selection of key features, and training the model. The model is implemented in a cloud platform, where it achieves an accuracy of 97%, which characterises it as a reliable tool for monitoring and managing animal health. Other topics in this group of publications are: a method for expanding the number of hidden layers and the size of the input layer of a multilayer perceptron in artificial neural networks for time series prediction is proposed, which accelerates network training and creates opportunities for more efficient data processing; an approach for predicting events in livestock farms is shown, more accurately predicting milk yield for each individual animal using machine learning models, including three regression machine learning models created with data collected from a smart animal farm; IoT solutions for classifying animal activity are shown, using data from accelerometers and gyroscopes to train an LSTM model, which achieves 96% accuracy in recognising the current activity of animals. These results show how important it is to look for more unconventional approaches to implementing standard algorithms, while optimising the accuracy and adaptability of models for specific tasks. The results show the significant potential of machine learning and artificial intelligence in the digitalisation of modern livestock farming and demonstrate how the integration of innovative technologies, e.g. IoT devices placed both on animals and on nearby or distant objects, contributes to the collection of valuable data. The prototypes have been tested in real conditions to confirm their effectiveness, which opens up opportunities for implementation and actual improvement of practices in the livestock sector.

Personal Impressions

I have been following the development of Dr. Kristina Dineva since 2020, when I was a reviewer in the procedure of her doctoral dissertation's defense. My personal impression is that Kristina began building a career as a researcher in informatics relatively recently - in 2017, when she headed for full-time doctoral studies at IICT. For 8 years spent at IICT, she has 29 publications. Falling into the context of the tasks on which her scientific supervisor Prof. Tatyana Atanasova is working, Kristina demonstrates exceptional adaptability and efficiency, as well as hard work and perseverance. Without downplaying the importance of the role and contribution of Prof. Atanasova and the fruitful effect of the creative atmosphere at the National Research Programme "Intelligent Animal Husbandry", in which a wide field for development and growth was provided to ambitious associates, I would say that Kristina was able to take maximum advantage of the combination of favorable circumstances and grew in 8-9 years as a specialist in the areas in which she worked. Her good competence in several programming languages, software development environments, cloud technologies and data visualisation tools, as well as the accumulated knowledge in machine learning and artificial intelligence

allow Dr. Dineva to be both a successful software developer and an effective researcher who has the capacity to quickly and qualitatively complete set scientific and scientific-applied tasks.

In the future, she will face the tasks and obstacles that every young associate professor at IICT faces: to find a field for personal expression, a topic for her own original results, to start generating her own ideas for projects, to attract her own doctoral students and build her own group, etc. I hope that Dr. Dineva will succeed in creating international partnerships and continuing her development as a leading scientist in joint developments with a wider range of specialists and with a more distant horizon.

Conclusion

I believe that Dr. Kristina Dineva is a recognisable young researcher who combines the qualifications of an excellent software engineer and a competent computer scientist. The publications submitted for the competition prove her capacity, in-depth knowledge, the ability to work in a team, as well as professional activity, perseverance, precision and the desire to reach a high scientific level. **I strongly support the election of Dr. Kristina Ivanova Dineva as an Associate Professor in the "Modeling and Optimisation" department of IICT-BAS and I propose to the esteemed members of the Scientific Jury to unanimously vote in support of such a decision.**

12 March 2025
Sofia

Member of the Scientific Jury for tl

На основание

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