REVIEW

on a competition for the occupation of an academic position "Associate Professor"
in the professional field 4.6. Informatics and Computer Science (Neural Network Architectures) for the needs of Institute of Mathematics and Informatics (IMI) of Bulgarian Academy of Sciences (BAS), announced in the State Gazette no. 69/11.08.2023 г. (p. 216, 80)

by **Prof. Dr. Olga Ilieva Georgieva**, Sofia University "St. Kliment Ohridski", Faculty of Mathematics and Informatics, Department of Software Engineering in professional field 4.6.Informatics and computer sciences in the capacity of a member of the scientific jury for the competition according to Order № RD 468 / 10.10.2023 of Director of IMI-BAS

Only one candidate submitted documents for participation in the announced competition:

Galina Dimitrova Momcheva, IMI-BAS

I. General description of the presented materials

I was provided with the following materials and documents prepared by Dr. Galina Momcheva for participation in the competition:

1. Statement to the Director of IMI-BAS for admission to the competition; 2. Professional curriculum vitae according to the European semple; 3. Diploma for completed higher education; 4. Diploma for acquired educational and scientific degree "doctor". 5. General list of publications 6. List of publications for participation in the competition. 7. Hand-signed certificate of the original scientific contributions in the works for participation in the competition; 8. Summaries of the publications for participation in the competition in Bulgarian and in English; 9. Copies of the works under item 6; 10. General list of citations; 11. List of citations for participation in the competition; 12. State Gazette with the competition announcement; 13. Certificate of work in the specialty according to the requirements of Art. 24 para. 1 item 2 of the Law of Act of Development of Personel of Republic of Bularia (LADPRB); 14. Other documents: issued textbooks and study aids; list of PhD students; reference to participations and management of scientific research projects; applicant's certificates and references; 15. Sample reference for the fulfillment of the minimum national requirements under Art. 2b, paragraphs 2 and 3, and the requirements under Art. 2b, para. 5 of LADPRB, as well as the minimum requirements of IMI-BAS with evidence; 16. Declaration by a semple; 17. Declaration of consent for storage and processing of personal data.

I.1 Data on submitted application documents

It is clear from the submitted documents that the applicant fulfills the requirements of the law under Art. 24 para. 1 and 2 for holding the academic position "Associate Professor". The candidate holds diploma No. 34960/03.02.2011 for the educational and scientific degree "PhD" in the scientific specialty "Methodology of education in informatics and information technologies". According to the

certificate of work experience issued by the Varna Free University (VSU) "Chernorizets Hrabar", Galina Momcheva has an academic experience of more than 17 years, and her growth from the position of "Assistant" to that of "Associate Professor" is evident.

For participation in the competition under Art. 24 para. 3 of the LADPRB, the candidate submitted a list and corresponding copies of a total of 18 publications as follows - a monographic work, a book based on a protected dissertation work, 15 scientific publications in journals and conference proceedings and 1 collective monograph. It is clear from the NACID reference that the submitted publications for participation in the competition were not used by the candidate for participation in other competitions for occupying academic positions and scientific titles.

I.2 General characteristics of the candidate's scientific works and achievements

For participation in the competition under Art. 24 para. 4 of the LADPRB, a reference and relevant evidence for the fulfillment of the minimum national requirements from the LADPRB and the regulations for its application as well as in fulfillment of the requirements of IMI-BAS, are presented. All publications submitted for participation in the competition are in the field of computer science and informatics. The monograph is in English with the title "Artificial Neural Networks: Modelling, Engineering, and Design (Architectures. Models. Approaches. Methods. Perspectives)" with ISBN 978-954-715-752-1, published by University Publishing House of VSU, Varna in 2023 under the review of two specialists in the field. The work is of 151 pages and has an introduction, four substantive chapters, a summary of contributions and a bibliography of 144 titles. I believe that this paper has all the attributes of a monograph work and thus successfully meets the minimum national requirements for indicators B with 100 points.

All works from the list for participation in the competition were published after 2019. They are in English, as only the book based on the dissertation work and the collective monograph are in Bulgarian. Of the presented publications, 15 are referenced in the established scientific literature databases *SCOPUS* and/or *WoS*. The evidence in the materials provided and my reference showed that 9 of them were with IF or SJR. Thus, the requirement of the Rules for the implementation of LADPRB of IMI-BAS in art. 3(1).3 (supplementary – 25.03.2022), that of the submitted publications for participation in a competition for the academic position of "Associate Professor", the candidate must have at least 7 publications in publications with IF or SJR, is fulfilled. One of the publications is in a scientific journal with IF. Taking into account the stricter requirements of IMI-BAS compared to those of LADPRB for occupying the academic position "Associate Professor", I am confident that according to the indicators of group D, the works significantly exceed the minimum of 220 points, collecting a total of 301 points.

The available citations of the candidate's publications, visible in the approved databases, exceed the required number of 70 points to cover the minimum requirements of IMI-BAS for this indicator. The query in the *SCOPUS* system up to the date of the present review showed that 17 citations with an *h*-index of 3 were available, covering 102 points. Other citations of the works in other databases are also presented in the application documents, which assures that the collected points for indicator D are exceeded to a large extent.

 For the coverage of indicators from group E, Dr. Galina Momcheva presented evidence of one successfully defended doctoral student, of participation in international scientific and educational

projects, as well as two published study aids. Thus, points are protected for this group of indicators, at large exceeding the required minimum number of 20 points according to the requirements of IMI-BAS.

Other documents are also provided - diplomas, certificates and awards in support of the achievements of the application.

There is no proven plagiarism in the publications of Dr. Galina Momcheva submitted for evaluation.

From the review of the presented scientific works and all other materials of the application, it can be seen that they fully meet the minimum national requirements under Art. 24 of the LADPRB and its regulations, as well as the additional requirements of the Regulations of IMI-BAS for occupying the academic position "Associate Professor".

II. Brief biographical data

From the presented biographical reference, it can be seen that Galina Momcheva holds a master's degree in mathematics and informatics from the "Episkop K. Preslavski" University of Shumen. She worked as an informatics teacher at the "Dr. Petar Beron" Mathematical High School in the city of Varna, and in 2005 she began her academic career at the "Chernorizets Hrabar" VSU. She was the head of the Department of Computer Science at the same university. Since 2022, she is the chairman of the Biomed-Varna Foundation. From September 1, 2023, she was appointed as a mathematician at IMI-BAS.

In the mentioned report and documents, it can be seen that Galina Momcheva has a significant educational and organizational activity, including in the field of the competition, both with schoolchildren and with students. A strong impression is made by her work on educational and research projects, of which she is the initiator and active participant. In this activity, she managed to attract and engage young people, to form successful teams. From the biographical reference and the available documents, I understand that she is one of those people with a constant desire to improve and to meet new challenges.

III. Analysis of the applicant's scientific and scientific-applied achievements in the materials for participation in the competition

The scientific works contain scientific and applied results on the subject of the competition. In a large part of them, architectural solutions and applications of artificial neural networks (ANN) are presented for the solution of specific tasks in the field of biomedical images research, biological data analysis, the delivery of video signals, for modeling business processes. In some of the works, scientific results have been achieved through the datamining methods for extracting information and knowledge.

The monograph presents an extensive overview study of different concepts for building artificial neural networks, existing structural and architectural solutions. The success of applications by this apparatus to numerous tasks of the modern technological world is also highlighted, and in this connection new scientific goals and tasks are identified. The first chapter presents the parallel between biological and artificial neural networks and the learning process of ANN. The second chapter

discusses algorithmic approaches, and the third - structural solutions for building ANN. The fourth chapter presents problems of the application of this apparatus for modeling processes and solutions to specific tasks such as that of describing sound sensorics.

I consider as original and beneficial the applied approach of examining and analyzing ANN based on simulating or approximating the nested calculations to the existing (so far known) biological processes. The monograph presents two new solutions of a neural fuzzy network and a network with dendritic computations, which are developments of the author, presented in her other scientific works. A number of interdisciplinary approaches to the use of ANN have been posited, albeit very generally.

I consider a certain problem for the full understanding of the text to be the different depth and detail of presentation of the discussed issues. A large part of them are placed and marked as (unquestionably) useful/good solutions, but no concrete implementation and analysis of results is given. A shortcoming of a technical merit are inaccurately numbered figures and tables, citation, although correct, of figures from other sources, but without the necessary explanations of the designations, inconsistent passages in the exposition, inaccurate numbering of sections.

Regardless of the existing gaps in the layout of the monogrph, its originality in setting the task of building artificial neural networks, as well as the noted new ideas for future solutions should be emphasized.

I can evaluate the other contributions in the candidate's works as follows.

Scientific and scientific-applied results:

A. In Computer Vision and Image Processing:

– Procedure for structural segmentation and corresponding functional analysis in gene expression represented by images is proposed. It is based on algorithmic selection of texture features used for unsupervised image segmentation. Additionally, the feature selection is realized by a neural network-Deeep Learning Autoencoder with optimized structure and characteristics

– An algorithmic solution for automatic detection and accurate correction of errors in video images is proposed.

– An efficient method for simulating artifacts of typical problems in microscopic images, applicable to image generation to help train neural networks, has been developed.

B. Decision methods with artificial intelligence

– A hybrid artificial neural network architecture is proposed for solving biomedical image segmentation tasks. The architecture combines the advantages of the U-ANN and the methods of fuzzy sets and logic, achieving greater accuracy compared to the classical U-ANN.

– An innovative ANN model with two different structures with dendritic computations is proposed, the architecture of which simulates to a certain extent the structure and operation of the biological neurons.

– An innovative approach to knowledge extraction through process mining applied to biological processes is proposed.

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–   An algorithm was developed, implementing an original scheme for federated learning using a neural networking model, applicable to the NLP task of binary classification.

The following achievements with an applied score should be noted:

- A comparative analysis of text-to-numeric encoding techniques used to produce input to a regression ANN model for predicting the duration of software support cases.

- A studying technique of students' reading and programming skills.

- Survey of the state of the bachelor degree in information technology discipline in Canada.

- Analytical approach to evaluate the entrepreneurial initiative BioMed-Varna as an ecosystem

With an applied contribution for the purposes of the education are the two books - the one based on a defended dissertation and the collective monograph. The second comprehensively describes biometric security systems and reveals the use of convolutional neural networks in biometrics.

In conclusion, I believe that the candidate's works show an ability to apply the contemprary methods of Machine learning and Artificial Intelligence. Galina Momcheva's ability to be a driver of innovative scientific and educational initiatives both in the field of the competition and in interdisciplinary areas of scientific research is also undeniably demonstrated.

In my opinion, the applicant's works submitted for review show volume, content and scientific significance, fully covering the criteria for holding the academic position of "Associate Professor" at the Institute of Mathematics and Informatics – BAS.

IV. Critical notes and recommendations

I believe that the candidate's contributions suggest that she should focus more efforts on publishing in scientific journals. This is a greater challenge to the presentation of scientific production, but also one that provides greater visibility of the results.

I recommend a more thorough, detailed and analytical presentation of the contribution results, especially those in the monograph.

V. Personal impressions of the candidate

I do not know the candidate and have no personal impressions of her work.

VI. GENERAL CONCLUSION

After having familiarized myself with the materials and scientific works presented for the competition and based on the analysis of their significance and the scientific-applied and applied contributions contained in them, **I confirm** that the achievements meet the requirements of LADPRB, the Regulations for its application and the relevant Regulations of IMI-BAS for holding the academic position of "Associate Professor" in the scientific field and professional direction of the competition. In particular, the candidate fully satisfies the minimum national requirements and those of IMI-BAS

in the professional direction. No plagiarism has been found in the scientific works presented in the competition.

Based on the above, I recommend the scientific jury to propose to the competent authority for selection at the Institute of Mathematics and Informatics - BAS to elect Dr. Galina Dimitrova Momcheva to occupy the academic position of "Associate Professor" in professional direction 4.6.Informatics and Computer Science (Neural Network Architectures).

8.12.2023   Prepared the review: ....

Sofia   /Prof. Olga Georgieva/