R E V I E W

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on scientific works for participation in a competition to occupy the academic position „Associate
Professor" professional field 4.6 Informatics and Computer Science, published in a State
Gazette No 84/21.09.2022 with candidate Chief Assist. Prof. Metodi Georgiev Traykov.

This review is submitted according to Order No. 3-PK-68/01.12.2022 of the Rector of New Bulgarian
University (NBU) for members of the scientific jury in the current competition, as well as the decision of
the scientific jury dated 06.01.2023 (Protocol No 1/06.01.2023). It was prepared based on the Act For The
Development Of Academic Staff In The Republic Of Bulgaria, the Rules for its implementation, and the
specific rules for the Development of the Academic Staff of New Bulgarian University.

I. Assessment of compliance with the minimum national requirements and the requirements of New Bulgarian University

As a member of the scientific jury, I have received all required administrative documents and
scientific papers of the candidate: application for admission to the competition; creative autobiography; a
diploma for educational and scientific academy degree Doctor of Philosophy (PhD); a reference for
completing the national minimum requirements; documents, certifying the fulfillment of the requirements,
regarding an undergraduate teaching load, publications of study materials, work with students, participation
in research projects; a reference for original scientific contributions with the relevant evidence attached; a
certificate for an internship in the field; a list of scientific publication relevant to the competition; a list of
quotations; a declaration of absence of circumstances related to infringements of intellectual property rights;
the complete publications relevant for participation in the competition; medical certificate and criminal
record; other supplementary materials. The candidate meets the criteria of NBU for participation in the
competition and is admitted for participation by the University Committee for the development of the
academic staff, and the University Committee for Admission of Documents.

The provided materials for a review completely satisfy the requirements for occupying the academic
position "Associate Professor", according to the regulations and rules of the NBU, and only one candidate
has submitted documents for participation in the competition - Chief Assist. Prof. Metodi Georgiev
Traykov. The provided evidence of the candidate's self-assessment meets and exceeds the minimum
requirements of the Act for the Development of the Academic Staff in the Republic of Bulgaria and NBU.

II. Research (creative) activity and results

1. *Assessment of a monographic work.* The provided monographic work for participation in the
   competition is in the field of Bioinformatics. Bioinformatics is an interdisciplinary field, developing
   methods and software tools for interpreting biological data. As an interdisciplinary field,
   bioinformatics combines computer science, statistics, mathematics, and engineering to study and
   process biological data. Based on this definition, the provided monograph is in the mentioned above
   area. More specifically, the monographic work is related to the consideration and interpretation of
   models, algorithms (exact and heuristic), and approaches for predicting the tertiary structure of
   proteins, based on their amino acid sequences or primary structure, the so-called "Protein folding
   problem". The large number of scientific publications and citations in this area for the last ten years
   undoubtedly show the actuality of the topic, as well as that a large number of scientists try to find a
   solution to the mentioned problem. This, in turn, shows the dynamics in the development of models,
   algorithms, and approaches to solve this problem.

The main aim of the monographic work is to present models, algorithms, approaches, and techniques for predicting the protein's tertiary structure (the 3D structure). The author (the candidate) presents two points of view on the problem – the biologists' point of view, which is based on the biological characteristics of proteins, and the mathematicians' and programmers' point of view, which is based on integer optimization techniques, as well as algorithms for solving optimization problems, with the aim of using modern software such as CPLEX and GUROBI.

In the introduction of the monograph, the author emphasizes that most research associated with the protein folding problem are with high computational complexity. The analysis of the complexity of the problem and the presented different concepts for its solution makes the topic even more relevant and interesting. The monographic work may be likened to a progress in computational methodology, related to the prediction of the spatial structure of the proteins or solving the so-called "Protein problem folding" based on their amino acid sequences. The work brings added value to the study of the various approaches, techniques, models, and algorithms that are applied in bioinformatics research.

Also, I think that the monographic work can be considered as a successful attempt to apply the methods of discrete optimization to the study of the properties of proteins. The introduction is very well structured, explaining the relevance of the problem and the resulting tasks. The text abounds with figures and tables with experimental data, which makes it much easier to understand.

The scientific contributions of the monographic work can be summarized as follows:

- A serious review of algorithms and techniques for predicting the native structure of proteins;
- Representing the protein folding problem as a 0-1 optimization problem;
- Developing algorithms for finding an optimal structure in a two-dimensional and three-dimensional lattice based on integer mathematical models for solving 0-1 optimization problems. The described results show that this approach is effective.
- Representing the protein folding problem as an optimization problem that maximizes the number of contacts between hydrophobic amino acids that are not adjacent in the primary structure of the proteins. In this case, the problem can be solved by algorithms, finding a path in a special "lattice" graph, and maximizing the contacts between certain vertices. Since these kinds of problems are usually *NP*-complete, any progress in solving them is met with great interest by scientists in the field;
- A large number of computational experiments have been conducted, using described mathematical models. The models were implemented on the input language for optimization software (CPLEX, GUROBI) to achieve this.
- Software for visualization of numerical results for protein folding problems;

The monographic work presents a substantial and in-depth study in the field of Bioinformatics. It has a complex, interdisciplinary nature and contains scientific, scientific-applied, and methodical contributions. My main remark to the text is that, despite the obvious effort to present the material as comprehensibly as possible for readers with less experience, there are places that present a fundamental difficulty. However, the monograph shows that the author has deep theoretical knowledge and abilities for independent scientific research. Therefore, I believe this research has a practical-applied character and will be useful to many specialists in the field of bioinformatics.

CONCLUSION. *I give a high grade to the monograph, provided for participation in the competition, because of its actuality and professionalism in the exhibition. The monograph fully meets the requirements for habilitation work.*

2. *Assessment of contributions in the attached publications.* The candidate provides 7 publications for participation in the competition. All publications are published after the defense of his dissertation thesis. All provided publications are published in specialized periodicals (journals) indexed by Web of Science and Scopus. Two of the works were published in journals with Impact Factor, one of these two publications is in a journal (with Impact Factor 1.403), which is indexed by Web of Science (Q4), and the other is in a journal with Impact Factor 0.27, indexed by Scopus (SJR(0.205)). The remaining 5 works are also published in journals indexed by Scopus and having SJR. Based on the author's

contributions provided by the candidate, I believe that he has made a major contribution to the publications provided for participation in the competition. All publications are in English.

Due to the fact that I am a co-author in publications [2] [4], [5], and [7] (the numbering here and below is according to the List with publications and Author contributions in scientific manuscripts included in the documents for participation in the competition), these publications will not be a subject of the current review. I leave the assessment of these publications and their contributions to the other members of the scientific jury.

The publications provided for the competition can be divided into a few scientific areas, according to their scientific topics. Publications [2], [3], [4], and [6] in the field of Bioinformatics. These publications are devoted to a well-known problem in bioinformatics, namely the problem of predicting the spatial structure of the proteins (Protein folding problem). This problem is one of the main scientific problems in structural bioinformatics. Its solution is of great importance for figuring out the functions of a given protein, which are much more closely related to the proteins' tertiary structure than to the primary structure. To solve this problem many scientists use mathematical models describing different types of lattices (square, cubic, diamond, triangular, etc.) or models considering the problem in the 3D space, the so-called non-lattice models.

Publications [3] and [4] also consider the protein folding problem but interpret the problem in a different light. Article [3] presents a multi-group classifier of protein folds based on a generalization of a Voronoi diagram, made by the authors of the article. A Voronoi diagram is a kind of complete partition of a metric space into regions close to each of a given set of points. This partition is based on distances to each point in a given set of points. The main idea of the classifier described in the article [3] is to determine to which protein family (a set of points in the context of a Voronoi diagram) belong a newly synthesized protein, thus the functions inherent to the proteins in this family will also be valid for the newly synthesized protein. For this purpose, the authors of the article (including the candidate) used convex hulls of points in terms of a metric known as Manhattan distance, leading to a generalized representation of a Voronoi diagram. I believe that this classifier can be a valuable tool in a pattern or image recognition.

As a conclusion for this group of publications, I would like to note that the candidate's monograph is also devoted to the protein folding problem, as well as quite a few of the candidate's publications in the last few years, which come out after a short search in Scopus (the provided for the competition articles and several other publications in this area) and other scientific databases. This underlines the candidate's research experience and skills.

In the list of publications provided by the candidate for participation in the competition, there are also publications in other scientific fields such as statistics (specifically regression analysis, article [5]) and chemistry (article [1]). Article [1] is the first part (based on the title and content of the article) of extensive research on the effect of -OH, -NH$_2$, -NO$_2$, and other substituents on the planarity (and the level of delocalization) of a series of flavones and flavonols. This feature is particularly important in terms of the biological activity of flavonoids. The article has an entirely scientific nature and describes a method for analyzing the effect of -OH, -NH$_2$, -NO$_2$, and other substituents on the planarity (and the level of delocalization) of a series of flavones and flavonols. The described results prove the beneficial effect of the described method. The work is published in a journal indexed by Web of Science with Impact Factor 1.403, which shows its quality and highlights the professionalism of the authors (including the candidate).

CONCLUSION. *The publications provided for participation in the competition are a small part of all publications of the candidate. Searching in well-known databases of scientific literature (Scopus, Web of science, ResearchGate, etc.), it can be seen that the candidate has more than 40 publications generated over a period of about 5 years. This is an indicator of serious research work. I believe that the candidate's research work, in the way presented in the documents provided for the competition, meets the requirements for receiving the scientific title "Associate Professor".*

3. *Citation by other authors.* For participation in the competition, the candidate has provided 11 citations. These citations are generated from 3 publications of the candidate. Five of these 11 citations are related to a publication [1], provided for participation in the competition, and were generated over a period of 1 year, which highlights the quality of this publication. The remaining 6 citations are

related to publications that are devoted to the protein folding problem. All citations, provided for participation in the current competition, as well as the author's publications associated with them, are indexed in Scopus. Here, I want to note that the provided citations are far from all the citations of the candidate. A simple check in the scientific databases shows that the candidate has more than 60 citations according to Scopus and more than 80 citations according to ResearchGate over a period of 7 years (H-index (Scopus): 5). This shows that the candidate has a high potential for scientific developments.

4. ***Assessments of the results from participation in research and creative projects.*** In his creative autobiography, the candidate indicated that he participated in 13 research and creative projects. A significant part of the mentioned projects (around 7) are financed by the Bulgarian Science Fund. Some of the projects (around 4) are international. The candidate participated in all projects as an expert. I guess that these participations in projects are the reason for the high publication activity and participation of Chief Assist. Prof. M. Traykov in several international conferences, as he indicated in his creative autobiography.

CONCLUSION. *I believe that the candidate's scientific work, as it is presented in the documents provided for the competition, meets the requirements for receiving the scientific title "Associate Professor".*

III. Learning and teaching activity

1. ***Auditory and non-auditory employment, work in the e-learning module "MOODLE – NBU".*** Considering the provided documents it is clear that the candidate's auditory and non-auditory activity is significant. He provided evidence for several courses (auditory and non-auditory) led by him. The grades of the students for his teaching work are high (most provided grades from the students are between 5 and 5.70). The candidate is a main lecturer of the disciplines of Programming and Object-Oriented Programming. He has developed several auditory courses in the mentioned above fields and not only that, one of the courses is in the field of bioinformatics. At present, the candidate continues to read lectures in these courses. Also, he is involved in teaching in the master program "Software technologies on Internet" with developed by him course "Introduction to Algorithms and Programming", to which he also developed a non-auditory course. The candidate has developed also "projects" for the auditory courses, which he teaches.

   The provided documents show that the candidate has a serious ***activity in the e-learning module "MOODLE – NBU"***. The learning materials created by him are in a volume exceeding many times (2-5 times in the last years) the requirements. The ongoing control of student assessment applied by the candidate is fully in accordance with the University's policy – nearly 50% of the positive grades given by him are the result of the systematically carried out ongoing control.
2. ***Work with Erasmus students.*** I do not know if the candidate has had any activity on the Erasmus programs.
3. ***Student survey ratings.*** Chief Assist. Prof. Metodi Traykov is highly valued by his students as a teacher. ***His grades*** in the surveys of the students he teaches range from 5.00 to 5.70, with the average value being much higher than the lower limit set by the University. Since he has recently been on staff at NBU (since 2019), there is no information about graduates under his supervision, but he is the author of many reviews of student theses.

CONCLUSION. *The candidate's teaching activity is definitely his strong side. It far exceeds the requirements of NBU in terms of quantity, and its quality is suitable for receiving the scientific title "Associate Professor".*

IV. Administrative and public activity

The documents provided for the competition show that the candidate regularly participates in the Departmental Council of the Department of Informatics of NBU, both in discussions and with a proposal to improve the department's work. Based on the provided documents I can conclude that he

presents reports of the Department's Scientific Seminar and participates in the scientific sessions (with a report) and organization of the annual international conference organized by the Department of Informatics of NBU in partnership with universities from Germany and the USA. Also, the candidate participates in the preparation of teams for the Republican Student Olympiad in Programming, which is also held annually.

CONCLUSION. *The administrative and public activities of the candidate are useful for the activities of the Department of Informatics and NBU and correspond to the University's requirements for the occupation of a habilitation position.*

V. Personal impressions of the candidate (if there are any)

I know Chief Assist. Prof. Metodi Traykov since he was a 2nd- year student, specialty "Informatics" at South-West University "Neofit Rilski", Blagoevgrad. During all this time, I had the opportunity to get to know him quite well, and my impressions of him are that he is an erudite specialist in the field in which he works, as well as a socially engaged person. A pleasant conversationalist with whom we often share our views on the teaching of Informatics in general and improving the training of the students in the field of Computer science. We have implemented and are on our way to implementing other scientific and educational projects.

VI. Opinions, recommendations, and remarks about the activity and achievements of the candidate

I have no remarks. I would recommend that the candidate directs his bioinformatic research towards applications in the biological field, where he could publish his work in journals with a high impact factor. Also, I recommend the candidate's efforts in research in the future to be focused on the application of even more powerful mathematical apparatus and computer tools for solving the problems of Mathematical modeling and Bioinformatics. This will allow the candidate to be more actively involved in prestigious international projects financed by the EU.

CONCLUSION

Chief Assist. Prof. Metodi Georgiev Traykov has many years of teaching, scientific, and scientific-applied activity. Based on what has been said so far about the provided materials, the scientific works, their significance, and the scientific and scientific-applied contributions contained in them, as well as the teaching activity and the work with students, I believe that Chief Assist. Prof. Metodi Georgiev Traykov, PhD, meets all the requirements of the Act For The Development Of Academic Staff In The Republic Of Bulgaria, the Rules for its implementation, and the specific rules for the Development of the Academic Staff of New Bulgarian University for the terms and conditions for occupying the academic position "Associate Professor" in professional field 4.6 Informatics and Computer Science, and **I GIVE A POSITIVE GRADE** to the candidate. In accordance with the positive conclusions I have made above for each element of the candidate's academic activity, I SUGGEST THAT HE BE ADMITTED TO ELECTION BY THE ACADEMIC COUNCIL OF NBU.

Data   Signature:….……………
30.01.2023   / Assoc. Prof. Ivan Trenchev, DSc /