OPINION

by Prof. Desislava Ivanova Paneva-Marinova, PhD

Institute of Mathematics and Informatics, Bulgarian Academy of Sciences

on the Dissertation for awarding educational and scientific degree "**doctor**" (PhD),

in the Area of Higher Education 4. Natural Sciences, Mathematics and Informatics,

Professional Field 4.6. Informatics and Computer Sciences

PhD Program „Informatics"

Author: Zhelyazko Petrov Terziyski

Topic: Using techniques from artificial intelligence to analyze and predict the properties of peptides

Scientific supervisor: Assoc. Prof. Stanka Ivanova Hadzhikoleva, PhD, University of Plovdiv "Paisii Hilendarski".

1. General presentation of the procedure and the PhD student

In accordance with Order № RD-21-237 from 29.01.2024 of the Rector of the University of Plovdiv "Paisii Hilendarski" I have been appointed as a member of the Scientific Jury to oversee the procedure for the defense of a dissertation titled "Using techniques from artificial intelligence to analyze and predict the properties of peptides" of Zhelyazko Petrov Terziyski for awarding the educational and scientific degree "doctor" in the Area of Higher Education 4. Natural Sciences, Mathematics and Informatics, Professional Field 4.6. Informatics and Computer Sciences, PhD Program "Informatics". The author is a PhD student at the Department of Computer Informatics, Faculty of Mathematics and Informatics, with scientific supervisor Assoc. Prof. Stanka Hadzhikoleva, PhD, University of Plovdiv "Paisii Hilendarski".

The presented Opinion is made in accordance with the Act for the Development of the Academic Staff in the Republic of Bulgaria, the Rules for its implementation and the Rules for the Development of the Academic Staff of University of Plovdiv "Paisii Hilendarski".

The set of materials by Zhelyazko Petrov Terziyski is in accordance with Article 36 (1) of the Rules for the Development of the Academic Staff of University of Plovdiv "Paisii Hilendarski".

Zhelyazko Petrov Terziyski was born on 12.07.1972. In 1998 he obtained a Master's degree with professional qualification "Electrical Engineer" at Technical University - Sofia, Plovdiv branch. From 1998 to 2022 he worked in business companies in management positions including leading R&D departments. Since 2022 he is an assistant at Trakia University.

2. Relevance of the topic

This dissertation presents the results of research using artificial intelligence techniques (viz. machine learning) to analyze and predict the properties of peptides and more specifically to design, develop and validate a software system to predict the biological activity of peptides using the QSAR method with the help of various artificial intelligence methods. The development is extremely relevant to the dynamic and rapidly evolving fields of biotechnologies and bioinformatics, and it is of great scientific and practical interest.

3. Knowledge of the problem

The realization of the dissertation goal requires in-depth theoretical knowledge and practical skills. It is evident from the dissertation and the materials presented that the PhD student has a solid theoretical background and comprehensive view of the contemporary technologies required to achieve the research objectives. He demonstrates good knowledge of the research object. He formulates clearly and performs the tasks leading to specific results. The research is presented competently and with well-founded analyses and inferences.

4. Research methodology

I consider the methodology used by the PhD student to achieve the formulated objectives and corresponding tasks to be appropriate, well-motivated and suitable for the successful implementation of the research, which is evident from the results obtained.

5. Characteristics and evaluation of the dissertation and contributions

The dissertation of Zhelyazko Petrov Terziyski contains 189 pages, presented by table of contents, abbreviations used, list of figures, list of tables, introduction, four chapters, conclusion including contributions of the dissertation, perspectives for future development, approbation, list of author's publications on the topic of the dissertation, noted citations, participation in research projects, declaration of originality and reliability, bibliography of 150 references in English, three appendices.

The object, subject, goal and objectives of the dissertation are presented in the **Introduction** and **Chapter 1**.

Chapter 1 presents the nature and characteristics of peptides, and a survey of current approaches and studies to predict their properties using various artificial intelligence methods is provided. The classical algorithm for in silico prediction of biological activity of peptides is described.

Chapter 2 presents a conceptual model of a software application for the analysis of physico-chemical properties and prediction of biological activity of peptides.

The Pep Lab software application itself and its functionalities are presented in **Chapter 3.**

Chapter 4 discusses the results of experiments performed with Pep Lab. These include different datasets generated and predicting the biological activity of peptides using several artificial intelligence models.

The **Conclusion** summarizes the results of the research tasks, presents the main scientific, scientifically-applied and practical contributions, as well as directions for future development of the research.

The dissertation is thoroughly developed. The problem area is competently and critically analyzed. The presentation of the developed prototype software system for predicting the biological activity of peptides is comprehensive, well-argued and appropriately illustrated. I accept the contributions formulated by the PhD student.

6. Assessment of publications and personal contribution of the PhD student

The author's list of publications on the subject of the dissertation includes 5 titles, 2 of which are indexed in Scopus or Web of Science. One publication is in a scientific journal with IF (*Applied Sciences-Basel*) in Web of Science and the edition has JCR quartile Q2. Three publications are in international refereed scientific journals and 2 - in proceedings of inter-national and national conferences. Four of the publications are in English and one is in Bulgarian. In three publications Zhelyazko Terziyski is the first author. Four publications are co-authored and one is independent. 2 citations have been observed. The PhD student had participated in 6 university research projects. He has presented results at 3 scientific conferences and 3 scientific research and educational seminars.

After reviewing the dissertation and the submitted materials, I believe that the formulated contributions and the obtained results are the personal work of the PhD student.

I have no critical remarks.

7. Abstract

The abstract is 32 pages long and correctly reflects the structure of the dissertation, the results obtained and the conclusions drawn from the study. The requirements of the Act for the Development of the Academic Staff in the Republic of Bulgaria, the Rules for its implementation and the Rules for the Development of the Academic Staff of University of Plovdiv "Paisii Hilendarski" have been met.

8. Recommendations for future use of the dissertation contributions and results

The topic and results provide certain opportunities for future development and new applications. I recommend Zhelyazko Petrov Terziyski to continue his research and expand their popularization.

CONCLUSIONS

The dissertation **contains scientific,** scientifically applied, and practical results**, which represent an original contribution to science** and **meet all the requirements** of the Law for the Development of Academic Staff in the Republic of Bulgaria, the Rules for its Implementation and the Rules for the Development of Academic Staff of University of Plovdiv "Paisii Hilendarski".

The dissertation shows that the PhD student Zhelyazko Petrov Terziyski **possesses** in-depth theoretical knowledge and professional skills in the scientific specialty "Informatics", **demonstrating** qualities and skills for independent conduct of scientific research.

Due to the above, I confidently give my *positive evaluation* for the conducted research, presented in the dissertation, abstract, achieved results and contributions, and *I propose the honorable scientific jury to award educational and scientific degree "doctor"* to Zhelyazko Petrov Terziyski in the Area of Higher Education 4. Natural Sciences, Mathematics and Informatics, Professional Field 4.6. Informatics and Computer Sciences, PhD Program "Informatics".

13.02.2024   **Scientific jury member**: ....

Prof. Desislava Paneva-Marinova, PhD