

Short report

on the thesis of Petar Rossenov Petrov
“Modeling Big Data Analysis Processes Using Generalized Networks”,
presented for awarding the educational and scientific degree “doctor”
in Professional area 5.3. Communication and Computer Technologies

Doctoral program: “Computer Systems and Technologies”,
Faculty of Technical Sciences,
Burgas State University “Prof. Dr. Assen Zlatarov” (BSU)

by Prof. Dr. Maria Nisheva-Pavlova, Sofia University “St. Kliment Ohridski”

Pursuant to Order УД-290 / 24.07.2025 of the Rector of BSU I was appointed a member of the scientific jury for the defense of the submitted thesis in professional area 5.3. Communication and Computer Technologies, entitled “Modeling Big Data Analysis Processes Using Generalized Networks”.

1. General characteristics of the dissertation and the presented materials

The dissertation is written in Bulgarian. It contains 148 pages of text, including an introduction, three chapters, conclusion, and list of references with 138 titles.

In addition to the dissertation, the following documents are also presented:

- abstract in Bulgarian language;
- curriculum vitae;
- copies of publications on dissertation results;
- report on the fulfillment of the minimum national requirements under Art. 26, para. 2 and 3 of the Act on the Development of Academic Staff in the Republic of Bulgaria.

2. Applicant data

Petar Petrov has a Bachelor's degree, completed at Paisii Hilendarski University of Plovdiv, and a Master's degree, completed at BSU “Prof. Dr. Assen Zlatarov”. In 2021, he was enrolled in part-time doctoral studies at the Bulgarian State University, doctoral program “Computer Systems and

Technologies”. He has significant professional experience as a teacher, administrative manager, and expert in informatics and information technology in the primary and secondary education system.

I have no immediate personal impressions of the applicant and his work.

3. Analysis of the content, results and contributions of the doctoral thesis

The doctoral thesis consists of six main parts: introduction, three chapters, conclusion, and list of references.

The introduction presents in brief the research area, motivates and formulates the goal of the dissertation.

The first chapter introduces basic concepts and results from several areas related to the topic of the dissertation: data mining, big data analysis, intuitionistic fuzzy sets, indexed matrices, generalized networks. The formulation of the goal of the dissertation is specified and deepened, and the tasks defined by the candidate to achieve this goal are indicated.

Chapter 2 discusses numerous applications of generalized networks and intuitionistic fuzzy estimators in big data analysis. A generalized network model of the DBSCAN algorithm is proposed and its applications on a specific dataset are analyzed. A generalized network model of the BIRCH method with intuitionistic fuzzy evaluations is presented. Appropriate applications of intuitionistic fuzzy evaluations are shown in solving non-trivial data analysis tasks, creating various types of decision support systems, etc.

In the third chapter, original models developed by the author, integrating intuitionistic fuzzy logic with popular algorithms for data analysis and algorithms for solving classical optimization problems, are discussed. Author’s software implementation of the created models and corresponding specific applications are presented.

The conclusion contains a statement of the contributions of the dissertation and information about the author’s publications based on the results of the dissertation and their noted citations in works by other authors.

The main contributions of the doctoral thesis of Petar Petrov may be summarized as follows:

- Algorithms with intuitionistic fuzzy evaluations have been developed for analyzing data on student achievement in the secondary education system.
- Intuitionistic fuzzy evaluations are defined for different types of workflows.

- Algorithms for solving the knapsack problem based on circular and elliptical intuitionistic fuzzy sets have been developed.
- A generalized network model of the big data clustering process using the DBSCAN method has been created.
- A generalized network model of the clustering process with the BIRCH method was created.
- An implementation of the Support Vector Machine method with intuitionistic fuzzy evaluations has been proposed for solving a specific task.

The dissertation makes a very good impression with the scope and depth of the presentation. The achieved results are original and significant and fully correspond to the goal.

4. Publications on the doctoral thesis

The results obtained in the doctoral thesis are presented in a total of eight papers, published as follows:

- four – in Springer *Lecture Notes in Networks and Systems*,
- two – Springer *Lecture Notes in Computer Science*,
- one – in the journal *Annals of Computer Science and Information Systems*,
- one – in Springer *Studies in Computational Intelligence*.

One paper on results of the dissertation has been accepted for publication and is due to be published in the Proceedings of the FQAS 2025 International Conference.

In this way, the minimum national requirements under Art. 26, para. 2 and 3 of the Act on the Development of Academic Staff in the Republic of Bulgaria and the additional requirements of the Burgas State University “Prof. Dr. Assen Zlatarov” for the acquisition of the educational and scientific degree “doctor” in professional area 5.3. Communication and Computer Technologies have been fulfilled and significantly exceeded.

5. Abstract

The abstract meets all the requirements for its preparation and fully and accurately presents the topic, purpose, content, achieved results, and contributions of the dissertation.

6. Critical Remarks and Recommendations

I have no significant critical remarks regarding the level of the research conducted and the quality of the results presented in the dissertation. My more significant remarks concern the text of the dissertation and its technical design. In places, the presentation is too fragmented and there is no clear logical connection between the individual parts of the text. There is insufficient argumentation for the choice of specific data analysis methods, the generalized network models of which are to be developed and studied within the dissertation. The table of contents at the beginning of the dissertation is unfinished. A small number of grammatical errors have been made, which can be easily eliminated.

These remarks do not detract from the overall very good impression of the dissertation and the significant results presented in it.

7. Summary

Summing up, I consider that the doctoral thesis of Petar Petrov satisfies the requirements of the national regulations and the specific conditions and requirements of BSU “Prof. Dr. Assen Zlatarov”. Its author has achieved significant research results that make an original contribution to the chosen field of study. My assessment of the dissertation, the abstract, the publications, and the scientific contributions of their author, Petar Petrov, is **positive**.

Therefore, **I advise the honorable scientific jury to award to Petar Rossenov Petrov the educational and scientific degree “doctor”** in professional area 5.3. Communication and Computer Technologies.

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Чл.2 от ЗЗЛД

Sofia, September 8, 2025

Prof. Dr. Maria Nisheva-Pavlova