REVIEW

By Prof. Magdalena Zlatkova Garvanova, PhD

University of Library Studies and Information Technologies – ULSIT

on a dissertation thesis for acquiring the educational and scientific degree "Doctor" in

professional field 4.6 "Informatics and Computer Sciences", doctoral program

"Informatics", IICT – BAS

Dissertation on the topic:

Optimization Algorithms for Data Management

Author:

Edjola Kristaq Naka

Scientific Advisor:

Prof. Vassil Georgiev Guliashki, PhD

By Order No 277/06.11.2024 of the Director of the Institute of Information and Communication Technologies – IICT, BAS Corr. Member D.Sc. Svetozar Margenov I have been included in the Scientific Jury in connection with the procedure for acquiring the educational and scientific degree "Doctor" in professional field 4.6 "Informatics and Computer Sciences", doctoral program "Informatics" by Edjola Kristaq Naka at IICT – BAS with a dissertation thesis titled *"Optimization Algorithms for Data Management"*.

As a member of the Scientific Jury, I received:

1. Dissertation thesis for acquiring the educational and scientific degree "Doctor" in English;

2. Abstract of dissertation thesis in English;

3. Full-text copy of publications on the topic of the dissertation;

4. Reference on the fulfillment of the minimum requirements of IICT – BAS;

5. Information for registration in NACID;

6. Other documents for the defense.

In the evaluation of the dissertation, the terms of the Law for Development of the Academic Staff in the Republic of Bulgaria (LDASRB), the Regulations for Implementation of LDASRB (Decree No 26 of February 13, 2019) and the Regulations of the IICT – BAS for the implementation of the Law for Development of the Academic Staff in the Republic of Bulgaria are decisive.

1. According to Art. 27 (1) of the LDASRB, "the dissertation work should contain scientific or scientific-applied results that represent an original contribution to science. The dissertation should show that the candidate has profound theoretical knowledge in the respective subject, as well as their abilities for independent scientific research."

2. According to Art. 27 (2) of the LDASRB, the dissertation work should be presented in a form and volume corresponding to the specific requirements of the primary unit. The dissertation work should contain: title page; contents; introduction; presentation; conclusion – summary of the obtained results with a declaration of originality; bibliography.

GENERAL CHARACTERISTICS OF THE DISSERTATION

The dissertation is characterized by high relevance and scientific significance because it *aims* to derive a new and effective Binary Volleyball Premier League algorithm for feature selection, which predicts Parkinson's disease with higher accuracy compared to most metaheuristic algorithms for optimization tasks of this type.

The research contains 165 pages, 25 figures, 33 tables and 287 relevant bibliographical sources and consists of an introduction, 3 chapters, conclusion, contributions and a list of publications on the topic of the dissertation.

Chapter 1 provides an in-depth introduction to the importance of optimization in data management and feature selection and serves as a theoretical foundation for metaheuristic optimization algorithms, Parkinson's disease, machine learning classification algorithms, and existing methods and algorithms for solving the feature selection problem. *Chapter 2* provides a comparative analysis of all proposed

algorithms, methods, and techniques for feature selection using machine learning classifiers and proposes a new metaheuristic in feature selection to improve its efficiency and effectiveness. *Chapter 3* outlines the experimental implementation and validation of the developed algorithms, techniques, and methods based on Parkinson's data.

PUBLICATIONS

The most important and significant results of the dissertation have been published in 7 prestigious publications in English, indexed in Scopus and IEEE, 1 of which has an IF and confirms the high quality of the scientific work. Four of the publications are independent, and the remaining three – in co-authorship, which shows the skills of the PhD student to work both individually and in a team with the active collaboration with the scientific advisor – Prof. Dr. Vassil Guliashki.

The publications provided for review many times exceed the required in the Regulations for Implementation of the Law for Development of the Academic Staff in the Republic of Bulgaria 30 points under Group G indicators, according to the minimum national requirements for obtaining the educational and scientific degree "Doctor" in professional field 4.6 "Informatics and Computer Sciences" and fulfill the minimum scientometric requirements of IICT – BAS. I have not identified plagiarism or other improper use of other authors' ideas in the scientific publications on the topic of the dissertation thesis.

CONTRIBUTIONS

Seven contributions of a scientific and scientifically applied nature have been formulated, which fully reflect the merits of the dissertation research:

1. An analysis of widely used metaheuristic optimization algorithms for data processing feature selection combined with machine learning methods was performed, with a special focus on Parkinson's disease prediction.

2. A comparative analysis was implemented to evaluate different feature selection methods for predicting Parkinson's disease using three machine learning classification algorithms as well as an analysis of the possibilities for optimizing their parameters using a generalized heuristic simulated annealing algorithm.

3. A new and efficient Binary Volleyball Premier League algorithm for feature selection is proposed that predicts Parkinson's disease with higher accuracy and faster convergence speed compared to most other metaheuristic optimization algorithms.

4. It is proposed to integrate the "opposition-based learning" technique into the Binary Volleyball Premier League algorithm, which improves the efficiency and accuracy in predicting Parkinson's disease.

5. A new hybrid metaheuristic of the Binary Volleyball Premier League algorithm and the Antlion Optimizer algorithm is proposed, which aims to search for a new optimal solution and improve the use of the Binary Volleyball Premier League algorithm through BALO advantages to improve the prognosis of Parkinson's disease and the efficiency of the binary metaheuristic algorithm.

6. A procedure for reducing the execution time of the hybrid metaheuristic algorithm Binary Volleyball Premier League and Antlion Optimizer, called the "occurrence list", is proposed, which improves its efficiency by avoiding redundant calculations of the fitness function.

7. An efficient method is proposed to reduce the dimensionality of the data and to select the most relevant features by incorporating two algorithms: a feature ranked based on cosine similarity, and the hybrid metaheuristic Binary Volleyball Premier League algorithm and the Antlion optimization algorithm in the most efficient time.

ABSTRACT

The abstract is formatted according to academic requirements and standards and accurately and truthfully presents the content of the dissertation. The presented results sufficiently cover the scope of the set goals and objectives and contain potential for upgrading and development in future research.

CRITICAL REMARKS AND RECOMMENDATIONS

I have no critical remarks, but rather recommendations that the PhD student continue to publish her scientific work in prestigious publications, refereed and indexed

in world-renowned databases of scientific information such as Scopus, Web of Science, ACM, IEEE, etc., and to apply the knowledge gained in practice.

FINAL COMPLEX ASSESSMENT

In conclusion, I can say that the presented dissertation work met the requirements of the Law for Development of the Academic Staff in the Republic of Bulgaria, the Regulations for Implementation of the Law for Development of the Academic Staff in the Republic of Bulgaria and the Regulations of the IICT – BAS for the implementation of the Law for Development of the Academic Staff in the Republic of Bulgaria, and contains significant scientific and applied scientific contributions. The achieved results give me reason completely convinced to *vote positively* and to propose to the respected Scientific Jury to award Edjola Kristaq Naka the educational and scientific degree "Doctor" in professional field 4.6 "Informatics and Computer Sciences", doctoral program "Informatics".

06.01.2025
Sofia   /Prof

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