

ATTITUDE
on the procedure for defense of a dissertation on the topic:
"AIDED DECISION MAKING FOR PUBLIC
TRANSPORTATION OPTIMIZATIONS USING BIG DATA"
to acquire
educational and scientific degree "doctor"
from

candidate: **Georgi Kalinov Yosifov,**

Field of higher education: **4. Natural sciences, mathematics and informatics /**

Professional field: 4.6. Informatics and computer science

Doctoral program: **Software Technologies - Software Engineering, Department:**

"Software Technologies,

Faculty of Mathematics and Informatics (FMI),

Sofia University "St. Kliment Ohridski" (Sofia University)

The opinion was prepared by: Assoc. Prof. Dr. Desislava Antonova Ivanova, Technical University of Sofia, Faculty of Applied Mathematics and Informatics (FPMI), Department of Informatics, in my capacity as a member of the scientific jury, according to Order № RD-38-599/28.10.2022 by the Rector of Sofia University.

1. General characteristics of the dissertation and the submitted materials

The dissertation consists of six chapters. The text is written in 180 pages and contains 76 figures and 17 tables. 108 literary sources and Internet pages are cited. The paper is supplemented with five appendices. Each chapter is divided into thematic sections, helping to describe the problems solved by the work. At the end of the dissertation, scientific publications on the subject are added, the contributions are listed, and a declaration of originality is attached. The dissertation seeks a solution to a problem concerning both the accurate determination of traffic levels in an urban environment and the use of data that are not defined as sensitive for citizens. The topic is extremely relevant, especially for large European cities with a large population, such as the city of Sofia. The first chapter examines the development of the population and transport in the city of Sofia, Bulgaria. Shows the economic effect that reduced traffic can have, presenting data from the 2020 COVID-19 pandemic by INRIX (INRIX, 2020). The importance and different ways in which the level of traffic can be determined and how this information

could be used to improve the quality of life are discussed. The second chapter examines a methodology for classification and analysis of the current state of data collection methods and determining traffic levels and presents a categorization of each of them according to selected criteria. Methods for predicting traffic load levels are reviewed with various examples and cited studies on the topic, and some basic types of neural networks that have been used in this dissertation are discussed. The third chapter focuses on analyzing time and positional data from public transport in two different cities - Edinburgh, Scotland and Sofia, Bulgaria. Possible ways of collecting periodic public transport data to be used as input to the algorithm and the visualization of its results after execution are considered. Experimental scenarios are described that validate the use of the algorithm and determine a high positive Pearson correlation between the algorithm indices and the actual traffic level. The fourth chapter presents the functional and non-functional requirements for the software modules for calculating the indices according to the algorithm presented in the previous chapter. The software modules, their interrelationships, input and output file formats, class diagrams, and preview screens are described. The fifth chapter describes the purpose of the created experiment and its stages. The experiment scenario is described and the various operations to prepare the data to be used by the machine learning mechanisms chosen to predict the results are also given. The results of the experiment are described, examples are shown, and comparisons are given of the performance of the various selected algorithms for single-step models (one time interval ahead in the future) or multi-step models. The sixth chapter of the dissertation presents summaries of the achieved results and outlines directions for future development.

The presented dissertation is in an up-to-date and rapidly developing field related to the application of machine learning methods and new technologies to support decision-making for the optimization of public transport with the power of big data.

2. Data and personal impressions of the candidate

Georgi Kalinov Yosifov began his dissertation work in 2018 as a doctoral student at the FMI of SU "St. Kliment Ohridski". The doctoral student obtains his bachelor's and master's degree in the FMI of SU in the field of software technologies.

I have no personal impressions of the candidate, but the materials submitted for review on the dissertation show that Georgi Yosifov has excellent knowledge in the field of the research area.

3. Content analysis of the scientific and scientific-applied achievements of the candidate, contained in the presented dissertation and the publications to it, included in the procedure

The publications presented by Georgi Yosifov included in the procedure, as well as the exposition and the conclusions drawn in the dissertation work, give me the reason to accept the contributions formulated in the dissertation work, defined as scientific-applied and applied in nature.

4. Approbation of the results

Georgi Yosifov has presented 3 publications related to the dissertation. In all three publications, the PhD student is the first author. All of them have been published in international scientific journals with publishers ACM and Springer, with "impact rank", and are indexed in the scientific database SCOPUS. All publications have been presented at international scientific conferences. In addition, citations of the dissertation's publications related to the dissertation work are also noted. The publications presented by Georgi Yosifov fully cover the requirements for obtaining the educational and scientific degree "Doctor" in PN 4.6 Informatics and computer sciences.

5. Qualities of the abstract

The abstract meets the requirements and contains the basic information and accurately and clearly reflects the contributions to the dissertation.

6. Critical remarks and recommendations

I have no critical remarks. The dissertation is written at a high level.

7. Conclusion

After getting acquainted with the dissertation presented in the procedure and the accompanying scientific papers and based on the analysis of their significance and the scientific and applied contributions contained in them, **I confirm** that the presented dissertation and scientific publications to it, as well as the quality and originality of the results and achievements presented in them, meet the requirements of the Law on the Protection of Human Rights and Fundamental Freedoms, the Regulations for its application and the respective Regulations of Sofia University "St. Kliment Ohridski" for obtaining by the candidate the educational and scientific degree "Doctor" in the scientific field 4. Natural Sciences, Mathematics and Informatics and Professional Field 4.6 Informatics and Computer Science. In particular, the candidate satisfies the minimum national requirements in the professional field and no plagiarism has been established in the scientific papers submitted at the competition.

Based on the above, **I recommend** the scientific jury to award Georgi Kalinov Yosifov educational and scientific degree "Doctor" in scientific field 4. Natural Sciences, Mathematics and Informatics, professional field 4.6 Informatics and Computer Science.

17.01.2023

Signature:

(Assoc. Prof. Dr Desislava Ivanova)