OPINION

by prof. Eugenia Kovatcheva, PhD

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for the acquisition of the educational and scientific degree "doctor" in the

professional area "4.6 Informatics and Computer Sciences",

PhD program "Software Technologies" - Software Engineering,

order No. RD-38-599/28.10.2022 of the Rector of SU St. Kliment Ohridski

with a PhD thesis on:

SUPPORTING DECISION-MAKING TO OPTIMIZE
PUBLIC TRANSPORT WITH THE HELP OF BIG DATA
presented by Georgi Kalinov Yosifov,

PhD student at the Department of Software Technologies at the FMI of the SU

with scientific supervisor Assoc.Prof, Milen Yordanov Petrov PhD

I. **Evaluation of the qualities of the PhD thesis**

The topic of Georgi Yosifov's dissertation work is an up-to-date multi-component optimization task for public transport in large cities by determining, researching and forecasting traffic load levels. For the optimization, a design is made for the collection and processing of large data sets by detecting different parameters from different sources to achieve a result in this dynamic area. From the presentation of the dissertation work, it is clear that the doctoral student knows the problem area very well, he has studied 105 sources. 15 of the sources are older than 10 years. Of course, it should be noted that optimization methods have a long history.

The aim of Georgi Yosifov's dissertation is to support decision-making for the optimization of public transport by determining, researching and predicting traffic congestion levels using data collected from positional coordinates of periodic public transport used as a traffic sample. To achieve this goal, the doctoral student has set himself seven tasks, which he unfolds in 4 chapters, an introduction and a conclusion:

2. Comparative analysis of the current state of research in the field of methods of data collection and determination of public transport traffic levels

3. Urban traffic load index based on positional data from periodic public transport

4. Description of the created software tools for conducting the experiments

5. Traffic Load Index Prediction.

It makes a good impression that after each chapter the contributions of the doctoral student are indicated and where they were published. For example, in section 2.4 Contributions

Different types of methods for determining the traffic load in an urban environment are reviewed and categorized. An analysis of their characteristics by selected categories was made.

The results of this chapter are tested in:

Georgi Yosifov, Milen Petrov, Review of urban traffic detection approaches with accent of transportation in Sofia, Bulgaria, Proceedings of Seventh International Congress on Information and Communication Technology. Lecture Notes in Networks and Systems, vol 465., editor/s:Yang, XS., Sherratt, S., Dey, N., Joshi, A., Publisher:Springer, 2022, pages:509-517, ISSN (print):978-981-19-2396-8, ISSN (online):978-981-19-2397-5, doi:https://doi.org/10.1007/978-981-19-2397-5_47, Ref, IR , SCOPUS, SJR (0.17 - 2020), SCOPUS Quartile: Q4 (2022), ∂p.(INSPEC, WTI Frankfurt eG, zbMATH, SCImago), PhD

The experiment that the PhD student did, from the theoretical formulation to the implementation, raises several questions Georgi Yosifov student presented two productions in the city of Edinburgh, Scotland and in Sofia, Bulgaria (Druzhba quarter), but:

- Who is the end-user of the application? The modules from *4.1 Requirements to the software for conducting an experiment* to *4.3 Software for measuring transit times of public transport through Druzhba district, Sofia* are descriptive in detail. The description lacks the end user who sets the task. Does the application create in this way meet the needs of the end user as the PhD student in 4.1 thinks?

- How did the PhD student do the research for Scotland – using open data for Edinburgh or …?

- How the doctoral student would collect data for the Druzhba quarter - the staging of his work requires the use of sensors. Which way would you put it? What is the legal basis for putting them up for the purposes of experiential staging? Has it been thought of along these lines?

The abstract corresponds to the submitted dissertation work.

II. **Dissertation Research Contributions**

The doctoral student right at the beginning in section *1.3. Practical applicability and benefits*, presents his view of what benefits can come from its development, namely:

Data on the traffic load in an urban environment, at a current moment or a future one, can be used to extract from them the necessary information for the optimization of public transport. They can be published as open data, for use by the public, or be useful in the creation of state or municipal policies related to the construction of infrastructure and the distribution of public resources. By correlating with data from CO2 emission sensors, air pollution levels could be monitored and future peaks predicted. This information can also be taken into account by routing software used by private individuals, various companies in the forwarding industry or those making deliveries to homes, so that drivers can choose the most optimal routes. All these applications are part of the practical benefits of the result of the work developed.

Georgi Yosifov in his thesis has the scientific-applied and applied contributions as follows:

Scientific and applied contributions

1. Different types of methods for determining the traffic load in an urban environment are reviewed and categorized. An analysis of their characteristics by selected categories was made.

2. A statistical analysis was made of data on the transit times of vehicles from periodic urban transport, calculated from two heterogeneous sources from the city of Edinburgh, Scotland and the city of Sofia, Bulgaria, through selected road segments.

3. An algorithm was developed based on the statistical analysis, with the help of which the degree of congestion of a road segment can be indirectly determined. Through a number of experiments, the qualities of the presented algorithm have been determined and verified.

4. Made a comparative analysis of the results of single-step and multi-step machine learning models to determine traffic load levels at a future time.

Applied Contributions

1. A set with software solutions is developed for collecting, processing, calculating and visualizing the level of traffic load, by means of the presented algorithm, offering the possibility of modular integration to support different types of input data.

III. **Personal data**

Georgi Yosifov graduated with a bachelor's degree in Computer Science from Sofia University and obtained a master's degree again there in Software Engineering.

IV. **General description of the achievements and scientific works of the candidate**

The achievements of Georgi Yosifov's dissertation have been published in three publications, two of which in Q4. Total number of citations 4 in Google Scholar and 4 conference papers.

The presented articles for the acquisition of the educational and scientific degree "doctor" cover the minimum national requirements and the Regulations for the terms and conditions for the acquisition of scientific degrees and holding academic positions at SU "St. Kliment Ohridski".

V. **Notes and recommendations**

My main recommendation to Georgi Yosifov is to upgrade his CV more comprehensively. There are quite a few gaps in what is presented in the documentation.

Greater precision is needed in the exhibition as well. Observe different structures for example in chapter 3 there is section 3.1 Introduction and only in this chapter, Introduction different from chapter 1 Introduction. Images for scientific publications with different keywords should be cited as the source of the relevant database. They are presented in this way as if the doctoral student made them. Pay attention to the citation of all sources.

VI. **Personal impressions of the candidate**

I do not know Georgi Yosifov in person. I have impressions only from the materials presented. The systematicity of the work is impressive, but he omits some details that he clearly considers unimportant, but for a person who does not know him - the details provide additional information.

VII. **Conclusion**

The comments and remarks made do not detract from the achievements of doctoral student Yosifov. I recommend the scientific jury to award to Georgi Kalinov Yosifov the educational and scientific degree PhD in scientific field 4.6 Informatics and computer sciences" the doctoral program "Software technologies" - Software engineering.

January 18 2023 г.   Prepared the opinion: ....

prof. Eugenia Kovatcheva