

OPINION
on a Ph.D. Thesis

**Intelligent Information Systems In Bioinformatics:
Semantic Integration, Analysis and Classification of Biomedical Data**

presented by Iliyan Nedkov Mihaylov
for acquiring of the educational and scientific degree "Doctor"
in Professional field 4.6. Informatics and Computer Science,
Doctoral program "Information Technology - Bio and Medical Informatics"

Member of the Scientific Jury:

Prof. D.Sc. Stoyan Nedkov Kapralov, Technical University – Gabrovo

The opinion was prepared on the basis of an Order of the Rector of Sofia University № RD 38-255 / 02.06.2021 and a decision of the first meeting of the scientific jury, held on 11.06.2021.

1. Data on doctoral studies, dissertation, thesis summary and publications

This procedure is conducted in accordance with the Regulations on the terms and conditions for acquiring scientific degrees and holding academic positions at Sofia University “St. Kliment Ohridski”. Iliyan Mihailov was a full-time doctoral student at the Department of Computer Informatics at FMI from 02/15/2018 to 02/15/2021 with supervisor Assoc. Prof. Dr. Dimitar Vassilev. He was exmatriculated with the right to thesis defense.

The dissertation has a total volume of 186 pages and consists of five chapters.

The research in the dissertation is in a multidisciplinary field, which uses advances in informatics, information technology, large databases, artificial intelligence and bioinformatics. In particular, the dissertation is dedicated to the problems related to large data sets and their integration in the field of application of medical and biological research and practice.

Chapter 1, which is also an Introduction, is an overview. The main points from the field of research are presented, as well as the structure of the dissertation. Section 1.2 lists the main parameters of significance and relevance of the dissertation, 1.3 substantiates the complexity of the problem, 1.4 describes areas and means of research, section 1.5 describes in detail the goals and objectives of the dissertation and in 1.6 the structure of the dissertation is presented schematically.

Chapter 2 also has an overview character, focusing on the theoretical foundations and analysis of the situation on the issues of integration, analysis and classification of biomedical data. The main problems of large data storage, data transfer, data management and analysis are briefly described. Much attention has been paid to the classification of non-relational databases. A detailed literature review of methods and technologies for data integration is made. The main focus is on the technologies and models for semantic integration through ontologies and non-relational databases.

It is clear from Chapter 2 that Ilian Mihailov knows very well the current state of research in this area. The list of used literature contains 151 titles.

Chapter 3 presents the methods and models for data integration developed by the dissertation, as well as some applications. Section 3.3 describes the author's methodology for the semantic integration of biomedical data from different diseases. Section 3.3.4, "Model for predicting the survival of cancer patients", proposes a new universal prognostic parameter - TICF. Section 3.7 briefly presents a new approach to data compression.

Chapter 4 describes the software tools developed for the integration of biomedical data. Section 4.1 presents the system architecture in detail. Section 4.2 presents the generally developed software solutions. The following sections present in detail software solutions for predicting protein structures, a counseling system for consulting patients with diabetes, for integration, classification and analysis of metagenomic data. Section 4.6 presents the software implementation of the sequence data compression algorithm.

Chapter 5 has the character of a conclusion and could be merged with the Conclusion.

The list of publications on the dissertation is impressive.

[C1] is a patent application;

[C2] is an article with an impact factor, in Q1 quartile, there are 11 citations;

[C3] is in Q3 quartile, 4 citations;

[C4] is in Q3 quartile, 5 citations;

[C5] is in Q3 quartile;

[C6] is a report at an international conference;

[C7] is in Q3 quartile, 1 citation;

[C8] is an article with an impact factor, in Q2 quartile;

[C9] is a report at an international conference;

[C10] is a report at an international conference.

All publications are in English. I accept that the contribution of the co-authors in the joint publications is equal.

Rarely in dissertations submitted for the educational and scientific degree "doctor" it happens to present data about citations. Four of the dissertation publications have been cited a total of 21 times.

Iliyan Mihailov is recognizable in the international scientific community. It is visible in Scopus with 8 publications, 28 citations from 28 documents and has a Hirsch index $h = 3$.

The abstract is prepared according to the requirements and correctly reflects the content of the dissertation.

2. Scientific contributions

The contributions of the dissertation are scientific and scientific-applied.

3. Remarks on the dissertation

I have no remarks on the dissertation.

4. Conclusion

I believe that **the presented dissertation fully meets the requirements** of the Academic Staff Development Act in the Republic of Bulgaria, the Regulations for its application and the Regulations on the terms and conditions for acquiring scientific degrees and holding academic positions at Sofia University "St. Kliment Ohridski".

The dissertation contains scientific and applied scientific results, which represent an original contribution to science. The candidate has in-depth theoretical knowledge and abilities for independent research.

I assess positively the presented Ph.D. thesis and the achieved results give me grounds to **convincingly propose** to award the educational and scientific degree "Doctor" to Iliyan Nedkov Mihailov in Professional field: 4.6. Informatics and computer science.

21.08.2021 г.

Gabrovo

Member of the juri:

/Prof. DSc Stoyan Kapralov/