R E V I E W

by **Corresponding Member Lyubka Doukovska, DSc**

from the Institute of Information and Communication Technologies,

at the Bulgarian Academy of Sciences,

on the Thesis for awarding educational and scientific degree **PhD**,

under the Scientific Field: **4. Natural Sciences, Mathematics and Informatics,**

the Professional Area: **4.6. Informatics and Computer Sciences,**

the Scientific Specialty: **01.01.12. Informatics**

Author of the PhD Thesis: **Mariya Grancharova-Hristova**

Thesis Title: **Research on the creation of semantic models in the field of humanities**

In accordance with Order No. RD-21-2231/27.11.2023 of the Rector of the Plovdiv University "Paisii Hilendarski", I have been appointed as a member of the Scientific Jury regarding the PhD thesis of **Mariya Grancharova-Hristova** for awarding the educational and scientific degree "Doctor of Philosophy" (PhD) in the Scientific Field **4. Natural Sciences, Mathematics and Informatics**, the Professional Area **4.6. Informatics and Computer Sciences**, the Scientific Specialty **01.01.12. Informatics**. The scientific advisors are Prof. Asya Stoyanova-Doycheva, PhD and Prof. Todorka Glushkova, PhD.

As a member of the Scientific Jury I have received:

1. Order No. RD-21-2231/27.11.2023 of the Rector of the Plovdiv University "Paisii Hilendarski";

2. Application for opening a procedure for acquiring the educational and scientific degree PhD;

3. European Curriculum Vitae;

4. Protocol No. 2-23/24 from 27.10.2023 of the preliminary discussion of the PhD Thesis in the Computer systems department at the Plovdiv University "Paisii Hilendarski";

5. Reference to the implementation of the minimum requirements of the of the Faculty of Mathematics and Informatics at the Plovdiv University "Paisii Hilendarski" for obtaining the educational and scientific degree PhD;

7. Abstract of the PhD Thesis;

8. PhD Thesis;

9. Declaration for the original scientific and applied scientific contributions;

10. List of the publications included in the PhD thesis;

11. Copies of the publications included in the PhD thesis;

12. Official notes No. RD-26-193 from 06.11.2023 for participation in projects at the Humanitarian High School „St. St. Cyril and Methodius".

In order to form the final evaluation of the dissertation, the requirements of the *Development of Academic Staff Act in the Republic of Bulgaria* are implemented the specific requirements in the Act's Institutional Regulation shall be taken into consideration, where the respective norms are:

1. Pursuant to Art. 6 (3) of the *Development of Academic Staff Act in the Republic of Bulgaria*, PhD thesis should contain scientific or scientific-applied results, which represent an original contribution in science. The PhD thesis must indicate that the candidate has in-depth theoretical knowledge of the relevant specialty and ability for independent research.

2. According to Art. 27 (2) of the specific requirements in the Act's Institutional Regulation, PhD thesis should be presented in a form and volume corresponding to the specific requirements of the primary unit. The PhD thesis should contain: a cover page; content; introduction; exhibition; conclusion - a summary of the results obtained with a declaration of originality; bibliography.

I. Actuality and significance of the PhD thesis.

The relevance of the PhD thesis is determined by the field of research presented, namely Artificial Intelligence. Artificial Intelligence is the science of the

concepts, methods and means of creating intelligent models for the study of natural intelligence.

The PhD thesis submitted for review is devoted to the application of semantic models. They allow existing knowledge to be structured into a concrete model that can be easily extended with new concepts in the future. The main aspect of the dissertation work is the structuring and presentation of the rich history of the Humanitarian High School „St. St. Cyril and Methodius" in the city of Plovdiv, through the activity of its students and teachers as a semantic model.

The aim of the PhD thesis is „to research semantic models that can be applied in humanities".

To achieve this goal, the following scientific tasks have been formulated:

1. Creation of a semantic model in the form of an ontology in the humanitarian field.

2. Creation of algorithms for automatic generation of questions from the ontology in Bulgarian.

3. Create an application using predefined configuration structures to create and insert information into the ontology.

4. Creation of an application for extracting information from the ontology based on the created algorithms.

II. Summary of the PhD thesis.

The PhD thesis consists of 201 pages. Its structure includes an introduction, five chapters, a conclusion, a declaration of originality of results, dissertation publications, a complete list of publications, a list of citations, a bibliography and an appendix.

In the "Introduction" of the PhD thesis, the necessity of developing and the positive sides of the semantic models used in the fields of science and education are presented. The goal of the dissertation work is formulated and the main tasks that will be followed in order to realize the goal are described. A strategy for the work of the conducted research is also presented.

In the first chapter „Current state of the research area" an overview of the Semantic Web and Semantic Modeling is made. Technologies used to represent information as semantic models are considered. Ontologies as semantic models are

presented. The need for semantics in e-learning is presented and various approaches to automatically generate questions from ontologies are explored and discussed.

The second chapter, „Structure of the ontology", describes the structure of the built ontology (classes, properties, and entities), the approaches that have been used to categorize the available information, and what relationships have been built to logically link the information.

The third chapter, „Algorithmic queries for generating different sentence types", discusses different types of questions and algorithmic structures written in SPARQL that can be used to extract information from the ontology and verify the correctness of the given answer.

In the fourth chapter, „Applications for creating an ontology and extracting information from it", logic diagrams of two applications are presented. The first application is „OnthologyGenerator" and describes the creation of JSON structures. By populating these structures with configured information, a new ontology can be created. The second application is „OnthologyReader" and is used to extract information from the ontology using SPARQL queries.

In the fifth chapter, „Analysis and verification of the proposed approach", a new ontology is presented, which was created based on the developed OnthologyGenerator application. Extracting information from it in the form of questions was done with the OnthologyReader application. This chapter examines the structure of the information returned by each algorithm, as well as the advantages of the proposed algorithms, their shortcomings, and how they can be improved in the future.

In the "Conclusion", a summary of the obtained results of the PhD thesis research is presented. Future directions for continuing work on the subject are also discussed.

The relationship between the chapters is ensured by the logic of the exhibition and allows for a thorough understanding of the scientific research.

The cited sources are sufficiently diverse and for the most part they are written by foreign authors. The presence of Bulgarian authors in the literature used also makes a good impression.

III. Evaluation of the PhD thesis's contributions.

During the achievement of the main goal and solving the tasks related to it, the following main results were obtained, and in summary:

1. A semantic model has been created in the form of an ontology within the humanitarian field.

2. Algorithms have been developed for the automatic generation of interrogative and declarative sentences from the ontology in the Bulgarian language.

3. An application called OnthologyGenerator has been developed in C#, using predefined configuration structures for creating and inserting information into the ontology.

4. An application called OnthologyReader has also been developed in C# for extracting information from ontologies based on the created algorithms.

I accept that the contributions so formulated could be considered to have scientific and common application. This separation would allow detailing the results obtained in accordance with the specificity of their significance.

IV. Assessment of the submitted publications.

Twelve publications are included in the presented complete list of publications of the PhD student, of which six publications are related to the PhD thesis, two of which are referenced in SCOPUS. The published results are original and I am not aware of any plagiarism.

The qualities of the presented papers have been proven by being published in papers at national and international conferences and in journals. The data thus presented give me reason to conclude that the research has been provided with the necessary publicity among the scientific community.

V. Evaluation of the PhD abstract.

The PhD abstract is consisting of 32 pages. It reflects the essence and content of the dissertation, including the purpose, subject, object and tasks of dissertation research and the ways of their realization.

VI. Remarks and recommendations.

In order to form the final evaluation of the PhD thesis, the requirements of the *Development of Academic Staff Act in the Republic of Bulgaria* and its Implementation Rules are to be taken into account, according to which I have the following remarks and recommendations:

1. Style errors are noted in the text of the PhD thesis.

2. The formulation of the PhD thesis results does not allow emphasizing the individual contribution of the PhD student.

3. The PhD student should focus her efforts on publishing her results in refereed scientific publications.

VII. Conclusion.

I accept that the requirements of the *Development of Academic Staff Act in the Republic of Bulgaria* and the specific requirements in the Act's Institutional Regulations for its implementation, the Rules for the conditions and the order for acquiring academic degrees and the Rules for the specific conditions for acquisition of academic degrees and occupation of academic positions at the Plovdiv University "Paisii Hilendarski" are accomplished.

After my introduction to the PhD thesis and its publications, an analysis of their significance and the contributions they make, I give my positive assessment and I recommend to the Honorable Jury to award the educational and scientific degree "Doctor of Philosophy" (PhD) to **Mariya Grancharova-Hristova** in the Scientific Field **4. Natural Sciences, Mathematics and Informatics**, the Professional Area **4.6. Informatics and Computer Sciences**, the Scientific Specialty **01.01.12. Informatics**.

20.12.2023   Signature: …………………...……………..

Sofia   /Corr. Member Lyubka Doukovska/