REVIEW

by Prof. Stanimir Nedyalkov Stoyanov, PhD

Plovdiv University "Paisii Hilendarski"

of a dissertation for awarding the educational and scientific degree PhD,

in the field of higher education: 4. Natural sciences, mathematics and informatics

professional direction: 4.6. Informatics and Computer Science

doctoral program: Informatics

Author: Maria Todorova Grancharova-Hristova

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

Scientific supervisors: Prof. Asya Stoyanova-Doycheva, PhD, Prof. Todorka Glushkova, PhD

1. General description of the presented documents

By order No. PD-21-2231 dated 27.11.2023 of the Rector of the Plovdiv University "Paisiy Hilendarski" (PU), I have been appointed as a member of the scientific jury to ensure a procedure for the defense of a dissertation work on the topic "Research on the creation of semantical models in the field of humanities" for the acquisition of the educational and scientific degree 'PhD' in the field of higher education 4. Natural sciences, mathematics and informatics, professional direction 4.6. Informatics and computer sciences, doctoral program Informatics. Author of the dissertation thesis is Maria Todorova Grancharova-Hristova, full-time PhD student at the Department of Computer Systems with scientific supervisors Prof. Asya Stoyanova-Doycheva, PhD and Prof. Todorka Glushkova, PhD.

The set of documents presented by Maria Todorova Grancharova-Hristova is in accordance with the Rules for the Development of the Academic Staff of the PU and includes the following documents:

• application form to the rector for opening a procedure;

• resume in European format;

• protocol of the preliminary discussion in the department;

• abstract of the dissertation;

• declaration of originality and authenticity of the attached documents;

• certificate of compliance with the minimum national requirements;

• list of publications;

• dissertation work;

• copies of the publications on the topic of the dissertation work;

• official memo No. RD-26-193 dated 06.11.2023 for participation in projects from the HG "St. St. Cyril and Methodius";

• opinions of the scientific supervisors;

• declaration of originality of results and contributions.

2. Brief biographical data for the PhD student

In 1991, Maria Grancharova-Hristova completed her bachelor's degree as a mechanical engineer at VTU "Angel Kanchev" - Ruse, and in 2005 a master's degree in software technologies at PU. In the period 2020 - 2023, he is a full-time PhD student in the "Computer Systems" department of the Faculty of Mathematics and Informatics (FMI) of the PU. In March 2023, she completed the PhD program. From 2000 to the present, she is a senior teacher at the "St. St. Cyril and Methodius". She was a part-time assistant in the FMI of the PU.

3. Actuality of the topic and appropriateness of the objectives and tasks

The problem investigated in the dissertation is of increasing relevance. The development of semantic models and knowledge bases, presented as ontologies, is an up-to-date task with opportunities for wide practical application. Of particular interest are ontologies related to the digitization of our cultural and historical heritage.

4. Knowing the problem

From the presented materials and my personal impressions, I can conclude that the PhD student knows the state of the issue in detail, is able to creatively evaluate literary sources related to semantic modeling and presentation of knowledge as ontologies. Proof of this is also the appropriately selected and up-to-date publications referenced in the dissertation, as well as the achieved research results.

5. Research methodology

The chosen methodology for conducting the research, consisting of six steps, is presented at the end of the introductory part of the dissertation. I think that the methodology is correctly selected and allows achieving the set goal, as well as solving the tasks formulated in the dissertation work.

6. Evaluation of the dissertation work

The dissertation has a volume of 201 pages, consists of an introduction, five chapters, a conclusion, a declaration of originality of the results, a list of publications on the dissertation, a complete list of publications, a list of citations, an alphabet of terms, a list of abbreviations, a bibliography, an appendix and a list of figures. The references including 162 sources is up-to-date and appropriately selected in accordance with the nature of the research. In my opinion, the dissertation is structured logically correctly and consistently presents the conduct of the research. Each chapter ends with a summary of the main results and conclusions.

In the introductory part of the dissertation, the necessity of conducting such research is motivated, the purpose of the research is clearly and comprehensibly formulated, and tasks for its achievement are specified. The tasks are appropriately formulated and contribute to the successful planning and conduct of the research. The structure of the dissertation is briefly presented.

In the first chapter, an overview of the state of the issue is made. I think it is appropriate and motivated to review topics related to the Semantic Web, ontologies and languages for their implementation, use of ontologies in different problem areas, environments and approaches for generating questions, reference architectures ViPS and DeLC. The conclusions at the end of the chapter provide a general framework for the study, which is detailed in the following chapters.

The second chapter presents the structure of an ontology that models knowledge related to the rich history of today's Humanities High School in the city of Plovdiv. The domain (humanities) and a plan to create semantic models for electronic testing are described. The core of this chapter is a specification of the base classes, summarized in two large groups - subject classes and object classes. A general classification of classes has been developed, according to which they can be: primitive, defined, compatible, incompatible, parent and relative. Two specific classifications have been developed - for subject classes and object classes. The identities and their properties intended for inclusion in the ontology are also specified. This chapter summarizes the results of a huge and precise research and design activity, which largely guarantees the successful implementation of the ontology. The metrics values summarized at the end of the chapter are impressive.

In the third chapter, numerous algorithms for generating different types of sentences are described. I want to emphasize that this type of generation is not a trivial problem. Algorithms for extracting information from the ontology in the form of interrogative and declarative sentences are written in the SPARQL query language. The information returned by them can be saved in JSON or other format and subsequently used in external systems, for example testing systems intended for training. I find very strong the idea that the generation of the different types of sentences is based on the type of the property. The following algorithms for generating: a question sentence with one right

and three wrong answers are presented in detail; a question sentence with two right and two wrong answers; communicative sentences with the addition of the correct answer; true and false communicative sentences; a question sentence with one right and three wrong answers, where the question is asked of two identities; a question sentence with one true and three false answers, where the question is posed by two object properties.

The fourth chapter is devoted to applications for creating the ontology and extracting information from it. Here, a tool to support the development of ontologies called OnthologyGenerator is presented. By implementing the chosen approach, the PhD student has noticed a repeatability in the use of the structures of the annotation properties in the different classes, object properties and data properties. In order to avoid the same actions in the process of creating the ontology, it was decided to create a generator that implements the general logic, and the generation of the specific structures for the different objects and identities is controlled by using configuration files. In addition, a second application called "OnthologyReader" is implemented, which uses SPARQL queries to the ontology in "RDF/XML" format and returns results in JSON format. The generated sentences in Bulgarian are stored in the results, depending on the executed request, implementing the corresponding algorithm. I highly appreciate this extremely successful decision.

In the fifth chapter, an analysis and verification of the proposed method is made. An ontology was created in order to analyze the results of the application of the proposed approach to generating and extracting information by formulating questions. The ontology is used to test the performance of the algorithms described in the previous chapter to determine whether they return meaningful and syntactically correct questions and how easily a new ontology can be created to work with the proposed method. The generated ontology models knowledge about the first Bulgarian state and its prominent rulers. The generation of the ontology was done with the "OnthologyGenerator" application, and the extraction of information from it in the form of questions was done with the "OnthologyReader" application. The ontology can be loaded into Protégé and the result of the chosen approach can be visualized. A detailed comparative analysis of query execution directly from Protégé and from OnthologyReader was made. Both applications return identical results. From the measurements summarized in Table 11, it is evident that OnthologyReader generates the answers faster – another confirmation of the extremely good result of the study.

In the conclusion, the results of the research are summarized. An attitude is taken on each individual task formulated in the introductory part. The relationship between the results, the tasks, the structure of the dissertation and the publications are presented in table 12. Briefly presented are ideas for continuing work on the problems of the dissertation work.

Summarizing, I want to emphasize that the dissertation work has been prepared very carefully. The style of the dissertation is very good, clear and easy to read, which supports the correct understanding of the text. The models, algorithms and methods are illustrated with very well-designed diagrams and charts. The results are summarized in well-made tables.

7. Contributions and significance of the development for science and practice

I think that the objectives of the dissertation and the tasks specifying them have been fully achieved. I would summarize the contributions of the research presented in the dissertation as follows:

- Scientific-applied - I would include the two software tools "OnthologyGenerator" and "OnthologyReader" in this group. Also, I think the semantic model for the field of humanities presented as specifications is a contribution from this group.

- Applied – implementing the specific ontology formally representing the rich history of today's Humanities High School, created during the Renaissance, I would define as an applied contribution.**7.**

8. Evaluation of publications on the dissertation work

The PhD student has indicated six publications reflecting the results of the dissertation. Two publications are referenced in SCOPUS. All posts are co-authored. Five publications are in English and one is in Bulgarian. The publications summarize various results of the conducted research.

The total number of publications of the doctoral student is twelve. One citation noted. The PhD student participated in two research projects.

9. Personal participation of the doctoral student

From the materials presented to me for review and from my personal impressions, I can claim that the results of the conducted research were mainly obtained with the personal participation of the doctoral student.

10. Abstract

The abstract is carefully prepared and summarizes the results of the dissertation work. Its volume is the usual volume.

11. Personal impressions

I have personal impressions about the PhD student. I think he consistently pursued the goal of the dissertation and thoroughly solved the tasks. The rich practical experience of the doctoral student

allowed him to create software tools of good quality. In addition, he handled his duties as a part-time assistant very well.

12. Recommendations for future use of dissertation contributions and results

I agree with the PhD student's views on continuing work on the dissertation topic. In addition to them, I think it would be appropriate to integrate the ontology and development tools presented in the dissertation into a single environment for the digitization of the Bulgarian cultural and historical heritage.

CONCLUSION

The dissertation contains scientific and applied results, which represent an original contribution to science and meet all the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria (ZRASRB), the Regulations for the Implementation of ZRASRB and the relevant Regulations of the PU. Paisius of Hilendar". The materials presented and the results of the research in the dissertation fully correspond to the specific requirements of the Faculty of Mathematics and Informatics, adopted in connection with the Regulations of the University of Applied Sciences for the application of ZRASRB.

The dissertation shows that the PhD student Maria Todorova Grancharova-Hristova possesses in-depth theoretical knowledge and professional skills in the scientific specialty of informatics (semantic modeling and ontological engineering), demonstrating qualities and skills for independent conduct of scientific research.

Due to the above, I confidently give my positive assessment of the conducted research, presented by the above-reviewed dissertation work, abstract, achieved results and contributions, and I propose to the honorable scientific jury to award the educational and scientific degree "doctor" to Maria Todorova Grancharova- Hristova in the field of higher education: 4. Natural sciences, mathematics and informatics, professional direction: 4.6. Informatics and Computer Science, PhD Program: Informatics.

15.01.2024   Reviewer: ....

(Prof. Stanimir Stoyanov)