

# REVIEW

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: **Sebiha Ahmedova Madanska**

Thesis Title: **Semantic modelling of the Bulgarian cultural and historical heritage**

In accordance with Order No. RD-21-200 from 26.01.2023 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 **Sebiha Ahmedova Madanska** 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 advisor is Prof. Stanimir Stoyanov, PhD, PhD.

As a member of the Scientific Jury I have received:

1. Order No. RD-21-200 from 26.01.2023 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. 3-22/23 of 09.12.2022 of the preliminary discussion of the PhD Thesis in the Computer Systems department;

5. Abstract of the PhD Thesis;
6. Declaration for the original scientific and applied scientific contributions;
7. 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;
8. List of the publications included in the PhD thesis;
9. Dissertation for the educational and scientific degree PhD;
10. Official note No. 340 of 16.12.2022 for participation in projects from the NPD at the Plovdiv University “Paisii Hilendarski”;
11. Copies of the publications included in the PhD thesis.

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, part of this study is also carried out through the means of semantic modeling.

The PhD thesis submitted for review is dedicated to the semantic modeling of the Bulgarian cultural and historical heritage, focusing on the houses from the Bulgarian National Revival period - with architecture and a prototype implementation of the ontologies for modeling.

The aim of the PhD thesis is „to build a unified ontological model with standardized data based on a semantic representation for its subsequent integration into a network of CHH ontologies called Cultural and Historical Heritage Ontology Network (CHH-OntoNet) to be used for the purposes of an intelligent tourist guide“.

To achieve the goal, the following tasks are defined:

1. Current state analysis and concept creation. The specificity of the area of interest defines the necessary steps to achieve the goal. The basis of each goal is investigation of the subject, and in this case, a comparative analysis of National Revival typological groups and houses. A variety of paper and e-sources, antiquary architectural books and dictionaries require examination. Consultations with experts, architects, specialists for maximum consistency and correctness of information are of extreme importance in the field of interest. The selection of suitable representatives is also one of the tasks towards the realization of the set goal.

2 Integration of numerous written and e-sources on the subject, which would give “new life” to unpopular knowledge but would also preserve the memory of the remarkable Bulgarian architecture (even if only virtually in some cases). After summarizing the results of the previous step, the question of the subsequent representation in a working framework arises. An internationally accepted standard for cataloguing cultural objects is an appropriate choice, including a detailed description of the objects of a cultural historical nature, building seven types and accompanying subjects, but also providing a certain freedom with respect to the case study.

3 Building a National Revival house model - basically satisfying all representatives on the territory of Bulgaria and at the same time allowing the expansion of their characteristics in certain sets of representatives and specific individual cases. Presentation of data for such specific cases.

4 Comparative analysis of National Revival houses in Bulgaria. Integration of all project modules into an ontology in order to test for inconsistencies and accurate

implementation of the axioms. In addition, the built ontological knowledge base can be extended and developed, implemented in different applications and contexts.

## **II. Summary of the PhD thesis.**

The PhD thesis consists of 158 pages. Its structure includes six chapters, a declaration for the original scientific and applied scientific contributions, participation in projects, a complete list of the author's publications, acknowledgments and a bibliography.

In the first chapter, the introduction of the PhD thesis is presented, the topicality of the topic is justified, the main goal is defined, and tasks for its achievement are formulated.

The second chapter „Overview of the problem area“ traces the progress in the scientific field and the motivation for the dissertation research. It defines concepts fundamental to the work such as ontology, semantic modeling; a review of studies and existing developments on the topic of the dissertation research is also done. Semantic models in historical terms, various technologies and languages related to the Semantic Web concept are described, as well as the specifics of the applied field of the dissertation research, namely - the Bulgarian cultural and historical heritage.

In the third chapter „Semantic modeling of ontologies for the domain“, the selected approach for semantic modeling of the domain of interest is considered, according to the specifics of an international standard for cataloging objects of a cultural-historical nature, a formal presentation of some concepts, of the method is also made for a visualization of existing ontologies as well as a brief comparison with relational databases.

In the fourth chapter „Architecture and prototype implementation of an ontology“ the semantic modeling for the purposes of the PhD thesis and the development of the ontologies - ontology Objects, ontology Materials, ontology Subjects, ontology Agents, ontology Locations, ontology Functionalities, ontology OldHouses is described. It is indicated that in the future the ontology Views will be developed to separate the images into a separate module.

In the fifth chapter „Applications and results“, some conclusions from the process of merging ontologies in the Protégé environment are discussed. The

typological determination is discussed and conclusions are made about the specifics of objects of a cultural-historical nature, sample requests for extracting information from the ontologies are also presented.

In the sixth chapter „Conclusion“ the results and contributions of the work on the dissertation are formulated. It is noted that in the Protégé environment, seven ontologies have been developed with the concept of semantic modeling of Bulgarian cultural and historical heritage, and in particular of Bulgarian Renaissance residential buildings. An international standard for cataloging cultural objects was used in the modeling of the concept.

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. Research of the problem area and creation of a concept - diverse information on the subject has been researched, structured and prepared for its subsequent modelling, according to the original goal of using it as a knowledge base (ontological) for an Intelligent Tourist Guide.

2. Modelling of a prototype of ontologies for the field according to defined criteria - for the accurate implementation of the ontology modules from the project, a cataloguing standard was researched and used, and a standard formal approach was used for their description.

3. Implementation of ontologies for the area of interest - seven ontologies have been created, discussed in Chapter 4 of this PhD thesis. A particular result is the OldHouses ontology (with an extremely detailed taxonomy) through which individual of the National Revival house can be modelled.

4. Integration and application. Comparative analysis of National Revival houses in Bulgaria. The tests of the already developed ontologies have passed successfully, as

evidenced by: the correct extractions with SPARQL queries, the successful implementation of all seven ontologies in a single ontology without wrong inferences, the correct logical interpretations of the Reasoners implemented in the Protégé environment and testing with the Test Generation Environment for the area of education. As a result of the defined characteristics of the typological groups and houses, comparisons between them have been modelled.

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.**

Four publications are included in the submitted list. Two of the publications are co-authored. All papers have been published in peer-reviewed scientific journals and papers in international scientific forums. The qualities of the presented works have been proved by being published at international conferences and journals.

The data presented in this way give me reason to conclude that the research has been given 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 contributions does not allow emphasizing the individual contribution of the PhD student.
3. The PhD student should direct his efforts to increase his contributions to reputable international 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 **Sebiha Ahmedova Madanska** 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**.

02.03.2023

Sofia

Signature: .....

/Corr. Member Lyubka Doukovska/