REVIEW

by Prof. Dr. Radoslav Yoshinov
Institute of Mathematics and Informatics
at the Bulgarian Academy of Sciences

of a dissertation for awarding the educational and scientific degree "**Doctor**" in the doctoral program "**Informatics**", professional field **4.6. Informatics and Computer Science**
author: Emanuela Dimitrova Mitreva
on the topic: "Methods and algorithms for personalization and adaptability in content management environments'

By Order No. 57/17.06.26 of the Director of the Institute of Mathematics and Informatics at the Bulgarian Academy of Sciences, I have been appointed as a member of the scientific jury in the procedure for defending a dissertation on the topic "Methods and algorithms for personalization and adaptability in content management environments" for awarding the educational and scientific degree "Doctor" in the doctoral program "Informatics", Professional field 4.6. Informatics and Computer Science by Emanuela Dimitrova Mitreva. I have been appointed to write a review on the first meeting of the scientific jury.

As a member of the scientific jury, I have received:

1. Dissertation for awarding the educational and scientific degree "Doctor";
2. Abstract of the dissertation in bulgarian and english;
3. Copies of the articles included in the dissertation;
4. Reference for the fulfillment of the minimum requirements of the Institute of Mathematics and Informatics at the Bulgarian Academy of Sciences for the acquisition of the educational and scientific degree "Doctor".
5. Other documents accompanying the procedure.

1. Relevance of the dissertation

The need for research and application of innovative technological solutions and discoveries is crucial for the development of society in the coming years. The exponential growth of digital resources and the increasing accessibility of information have transformed traditional approaches to knowledge management and created the need for new methods for its organization and use. The dissertation explores and systematizes modern approaches to personalized content provision in digital libraries based on artificial intelligence and machine learning methods, outlining the main problems and challenges in their implementation. The research focuses on the ways in which digital libraries can analyze user behavior, preferences, and context to provide dynamic content

tailored to each user's individual needs and interests. The study is based on the hypothesis that the application of appropriate methods of artificial intelligence and machine learning to adapt content in digital libraries leads to a higher degree of personalization, relevance and efficiency in providing information to users.

The subject of the dissertation is the process of adapting and personalizing content in digital libraries using methods and techniques of artificial intelligence and machine learning.

The subject of the study is approaches, models and algorithms for adapting information objects and resources in digital libraries in order to provide personalized content.

The aim is to develop new models, methods and tools for personalized content presentation that combine content characteristics of information resources, data from registers of interactions between users and documents, as well as metadata.

To solve this goal, 5 tasks have been formulated

I find that the goal set and the tasks formulated in this way are relevant, and the content proves the significance of the presented dissertation. I positively evaluate the topics and the research done in the dissertation.

2. Degree of knowledge of the state of the problem and general characteristics of the work

The dissertation is structured in an introduction, five chapters, contributions, a list of author's publications on the topic of the dissertation, a list of citations, a list of reported results, a list of figures, a list of tables, a glossary of terms and abbreviations used, a bibliography, a declaration of originality of the results.

The dissertation has a volume of 167 pages, contains 15 tables and 26 figures. 5 publications of the author related to the presented dissertation are presented. 4 citations were noticed, all in indexed sources related to the publications of the dissertation.

The results are presented on three international conferences and three reporting sessions of the Department of Mathematical Linguistics of IMI-BAS.

In the bibliography of the dissertation, 202 literary sources are cited: books, scientific articles and Internet publications.

On the basis of the overview analysis, the PhD student formulates the purpose and tasks of the dissertation.

To solve this goal, the following tasks have been formulated:

Task.1. To study the scientific achievements and results of current research on the use of artificial intelligence and machine learning methods to provide personalized content in digital libraries; Task 2. To explore the possibilities for applying the results of Task 1. to extract named entities from digital resources and integrate them as structured metadata; Task 3. To create a conceptual model of functional modules for recommending content in a digital

library, based on modern methods of artificial intelligence; Task 4. To develop and implement a prototype of the proposed functional modules and to conduct experimental testing to assess its effectiveness and applicability. Task 5. To analyze and interpret the results of the experiments conducted.

These tasks are solved in five chapters of the dissertation:

Chapter 1 formulates the object, subject, purpose and tasks in the context of the personalized presentation of content in digital libraries.

In Chapter 2. The theoretical foundations and analysis of modern approaches to personalization in digital libraries are presented.

In Chapter 3. Models and software components are proposed for the personalized presentation of content in digital libraries

In Chapter 4. The developed experimental implementation and analysis of the result testing is presented

in Chapter 5. set out the guidelines for future research and development.

The necessary requirements (points) have been exceeded in accordance with the Law on the Development of the Academic Staff of the Republic of Bulgaria, the Regulations for its implementation and the Regulations on the terms and conditions for acquiring scientific degrees at IMI-BAS. I have not noticed plagiarism.

All this proves that the PhD student has in-depth knowledge of the topics of the research carried out.

3. Correspondence of the proposed research methodology and the set goals and objectives of the dissertation

Conceptual and functional aspects of digital libraries, the role of the user and the need for personalization are examined. An overview of modern research and methods used for personalization in digital libraries is made. Models and software components have been developed for personalized content presentation in Digital libraries

Models, software components and an experimental environment for context-dependent use of digital resources are presented. Basic concepts, models and classifications related to personalization and recommendation systems are presented, and an analytical study of the scientific achievements and results of current research and scientific achievements for the use of artificial intelligence and machine learning methods for the provision of personalized content in digital libraries is carried out.

A multi-component similarity assessment method between multi-thematic documents is proposed, defined as a linear combination of indicators of global semantic proximity, local fragment matches, thematic profiles, and named entities. Document similarity scores are stored in a similarity matrix that both serves the "similar documents" functionality and supports the generation of personalized recommendations.

The chosen methods and means correspond to the main goal and tasks set for the PhD student.

4. **Characteristics of the nature and assessment of the credibility of the material on which the contributions of the dissertation are built**

The methods and models that are created and used correspond to the target tasks. The theoretical framework of the proposed architecture for personalized presentation of content in a digital library has been developed. A conceptual model of the system and the roles of its main components is presented - two functional modules for generating personalized content and one separate service for extracting and structuring named entities has been done.

The stages of data preparation and the creation of operational structures in the asynchronous layer are formed. Based on the created structures, two leading ways of providing personalized content have been defined in the interactive layer: (1) discovery of "similar documents", invariant for all users; and (2) 'personalised recommendations', whereby personalisation is achieved through a hybrid approach. I have not noticed any errors in either the concrete or the conceptual models. I also find that the proposed strategies are well founded.

5. **Contributions of the dissertation**

The more significant results obtained in the dissertation work are summarized in author's claims for three scientific and six scientific-applied contributions:

Scientific contributions:

1. A conceptual model and an architectural framework have been developed for the personalized presentation of content in a digital library. The operational structures and the relationships between them are formalized, which ensures reproducibility, traceability and compatibility between the modules.
2. A multi-component similarity assessment method between multi-thematic documents is proposed, defined as a linear combination of indicators of global semantic proximity, local fragment matches, thematic profiles, and named entities. Document similarity scores are stored in a similarity matrix that both serves the "similar documents" functionality and supports the generation of personalized recommendations.
3. An element-oriented hybrid algorithm has been developed for generating and providing relevant content according to the needs of users in a digital library.

Scientific and applied contributions:

1. A service for extracting and structuring named entities from texts in Bulgarian has been implemented.
2. A functional module for selecting "similar documents" has been implemented, generating personalized content on a parameterizable multi-component assessment for proximity between documents.

3. An element-oriented hybrid algorithm has been implemented, which is based on a rarefied user-document matrix.

4. Mechanisms for periodic updating and incremental complementarity of operational structures have been defined and implemented.

5. Experimental validation of the functional module "similar documents" was performed.

6. Experimental validation of the algorithm and the functional module for generating personalized recommendations has been performed.

The reviewer accepts scientific contribution (1,2,3).

The reviewer accepts the scientific and applied contributions (1,2,3). I do not accept as contribution 4 and consider that contributions 5 and 6 should be combined into a single scientifically applied contribution.

The reviewer accepts the contributions described in this way, recommending that the PhD student learn to briefly describe her achievements.

6. Degree of personal participation of the dissertation student in the contributions

I judge the personal participation of the PhD student by the publication activity of the PhD student, reflected in the materials published on the dissertation. The PhD student convincingly presents the results achieved, with very good and in-depth argumentation, as well as uses a professional graphic layout of the materials.

The nature of the research implies a very good and broad preparation in the field of innovative methods and applications, through the means of information and communication technologies, artificial intelligence and machine learning. A positive assessment was given to the doctoral student, emphasizing the overfulfillment of the required criteria for admission to defense.

I believe that the PhD student has done well, and I do not question her personal participation in the development of the dissertation material.

7. Evaluation of the publications of the dissertation

The attached list of posts contains 5 titles. Four of the publications are co-authored, and one is independent. All publications are in indexed editions (Scopus & Web of Science). Three of the publications have been made and presented at international conferences, and two, including the independent one, are in journals. One of the publications is in Q2, two are in Q4 and four are with SJR. This shows the ability of the PhD student to conduct scientific research in a team, as well as independently. So far, four independent citations have also been found.

The publications reflect the more significant results achieved in the dissertation. They have been reported on reputable scientific forums, which I take for approbation in scientific circles.

8. **Compliance of the abstract with the requirements for its preparation and adequacy of reflecting the main points and contributions of the dissertation**

The abstract is in Bulgarian and English. The Bulgarian version is 42 pages long, reflecting the essence and results achieved, as well as the author's contributions. The English version corresponds to the Bulgarian version and is 39 pages long. The presented draft abstract is graphically very well designed and includes the necessary information describing the dissertation in a summary.

9. **Opinions, recommendations and comments**

The dissertation examines a very complex, dynamically developing and promising area - the development of methods and algorithms for personalization and adaptability in content management environments.

A significant amount of scientific and applied research has been carried out, as models, software components and experimental environments for context-dependent use of digital resources using artificial intelligence and machine learning. A method for multicomponent assessment of similarity between multi-thematic documents is proposed. Experimental validation of the algorithm and the functional module determining the processes of pearsonolschozzia is performed.

I have no critical findigs and questions to the PhD student.

I recommend the PhD student to continue her active publication activity in indexed scientific journals with an impact factor.

I have reflected some non-essential (linguistic) notes on the copy that was provided to me.

10.CONCLUSION

The content and contributions of the dissertation of Mag. Emanuela Dimitrova Mitreva fully meet the requirements of the Law on the Development of the Academic Staff of the Republic of Bulgaria, the Regulations for its implementation and the Regulations on the terms and conditions for acquiring scientific degrees at IMI-BAS.. The educational doctoral minimum, set out in the individual plan, is covered. The personal participation of the PhD student in the development and the contributions received is indisputable. This gives me grounds to confidently recommend to the Esteemed Scientific Jury to award to **Mag. Emanuela Dimitrova Mitreva** the educational and scientific degree **of Doctor** in the professional field 4.6 "Informatics and Computer Science", specialty "Informatics"

REVIEWER:

/prof. Dr. R. Yoshinov/

Sofia, 07/08/2026