

# Review

Associate Professor Dr. Zlatinka Svetoslavova Kovacheva  
in the competition for academic position "Professor"  
in the professional field 4.6 "Informatics and Computer Science"  
specialty "Informatics (Information Modeling)"

Reviewer: Prof. Stefka Stoyanova Fidanova

By Order No 36 of 05.02.2020 of the Director of the Institute of Mathematics and Informatics at the BAS, Academician Veselin Drenski on the grounds of Art. 4, para. 2 of the law and the decision of the Scientific Council of IMI-BAS (Minutes No. 1 of 05.03.2020) I was appointed a member of the scientific jury under the procedure for the academic position of "Professor" in the professional field 4.6 "Informatics and Computer Science", scientific specialty " Informatics (Information Modeling) ", announced for the needs of section "Information Modeling" in the State Gazette no. 96 / 13.12.2019. As a member of the Scientific Jury I have received all the documents attached to the application to the Director of IMI-BAS of the only candidate for the competition, Assoc. Prof. Zlatinka Svetoslavova Kovacheva.

According to the Law on the Development of the Academic Staff in the Republic of Bulgaria, the regulations for its implementation and the specific requirements introduced in the regulations of IMI-BAS, applicants must meet the following requirements:

1. Have acquired a doctorate degree in education and science;
2. Have held the academic position of "Associate Professor" at the same or another higher education institution or scientific organization for at least two academic years;
3. Have submitted published monographs or equivalent publications in specialized scientific editions which do not repeat the ones submitted for the acquisition of the educational and scientific degree "Doctor", the scientific degree "Doctor of Sciences" and for the occupation of the academic position "Associate Professor";
4. Have presented other original scientific works, publications, inventions and other scientific and applied scientific works which are evaluated in aggregate;
5. Meet the national minimum requirements;
6. Not to have the lawful plagiarism proven in scientific works.

Associate Professor Zlatinka Kovacheva has acquired a dissertation for educational and scientific degree "Doctor" (diploma № 16620 / 31.03.1987, commission 5, protocol № 6 of 16.03.1987) on the basis of a defended dissertation.

Associate Professor Zlatinka Kovacheva occupies the academic position of Associate Professor by decision of the Higher Administrative Commission at the Council of Ministers of the Republic of Bulgaria (Commission 5, Minutes No. 5 of 29.03.2004). Certificate No. 22472 of 11.06.2004. Dr. Zlatinka Kovacheva has 5 years of experience, 5 months and 5 days as Associate Professor.

For Group B requirements, Zlatinka Kovacheva submitted 4 publications, one with an impact factor in Q2, one in Q3, one publication with an impact rank and one in the global indexing and referral system, without an impact factor or impact rank, the total number points is 102 for required 100.

For Group D indicators, a total of 14 publications are presented, 2 of them with Impact Factor, 5 with Impact Rank, 6 in the World Indexing and Referencing System, without Impact Factor or Impact Rank, and one book chapter. The total number of points is 235 for required 220.

Associate Professor Zlatinka Kovacheva submitted 192 citations after acquiring the academic position of Associate Professor, visible in WoS / SCOPUS. The total number of points is 1152 with a required 140 under indicator D. She has other 71 citations in dissertations and articles published in conference volumes.

Associate Professor Zlatinka Kovacheva was the coordinator of 7 projects with national funding, mainly with BTC and participant in 2 national projects. She has published two university textbooks and two university manuals for Middle East College, Muscat Oman, approved by Coventry University, UK. The total number of points is 210 with the required 150 under indicator E.

Associate Professor Zlatinka Kovacheva fulfills and, by some indicators, significantly exceeds the national requirements, as well as the specific requirements of BAS and IMI for the academic position of "professor".

The publications of Associate Professor Zlatinka Kovacheva are mainly in the field of information modeling, data mining and processing of big data sets. There are 4 main areas of work with application in business, telecommunications, medicine, socio-linguistic, management and other complex systems. The advantages and disadvantages of different methods of modeling fact tables in the data warehouse are analyzed. An architectural approach to building a data warehouse is presented, emphasizing monitoring for repetitions and data dependences. An innovative model has been introduced to allow the use of loose data. An approach for analyzing big data based on fuzzy logic is proposed. A comparison is made between statistical data analysis and machine learning. Emphasis is placed on the benefits of neural networks in the Big Data analysis process.

The linguistic compatibility of WEB services between Java and Microsoft .NET has been analyzed and some solutions have been proposed to make these services interoperable.

A data mining method based on associative rules is presented. The different approaches to data mining have been evaluated in order to give practical guidance on the use of analytical solutions. Neural networks have been used to extract and process knowledge.

The candidate also has several theoretical developments related to the application of neural networks. Continuous neural networks and their properties are considered. A discrete analogue of continuous neural networks is introduced and the discrete and continuous networks are compared.

Second-order impulse differential equations with non-local conditions are considered. The results obtained are a generalization of the results concerning such an equation without impulse effect. The existence and uniqueness of a mild and classical solution to the problem under consideration have been proved.

The main contributions to her research can be summarized as follows:

### **1. OLAP (on-line analytical processing) development**

The advantages and disadvantages of different methods for modeling fact tables in a data warehouse based on Inmon and Kimbal's basic approaches are analyzed. An approach for building a data warehouse with an emphasis on consistency and tracking dependencies and data duplication is presented. Trends in the development of the scope of a data warehouse are presented, with an emphasis on validation of the model with end users, identification of data sources, adaptation to current changes, life cycle and data integrity. A comparison is made between the data warehouse and traditional operational data. Two generations of data warehouse development are compared. An innovative model of regular sparsity map is presented, which allows performing operations with sets between map areas and rectangular domains from the multidimensional space of the cube. For more efficient execution of multiple operations with rectangular domains, an algorithm is proposed that works with subsets of the dimensions of the cube, together with specific points in space.

### **2. Big data**

Some aspects of Big Data analysis for cyber-physical systems are discussed. An attempt has been made to formulate the mathematical foundations of big data on the base of fuzzy logic. Some computational solutions and tools for analyzing big data are discussed. A comparison is made between statistical analysis and machine learning. The language compatibility of Web services between Java and Microsoft .NET is analyzed and some solutions are suggested.

### **3. Data Mining**

A method for data mining based on associative rules is proposed. The different approaches to data extraction have been evaluated. The experimental results show that

it is possible to create scenarios where the data can be used dynamically in established workflows for data mining. Neural networks for knowledge retrieval have been implemented. A comparison is made between neural networks and other methods. Emphasis is placed on the characteristics of neural networks, which increase their potential for data mining and artificial intelligence.

#### **4. Neural networks**

Two types of neural networks are considered: continuous and discrete. The global stability of a system of differential equations modeling the dynamics of additive neural networks with impulses in the case of continuous time is considered. Cases without delays, with discrete delays and with distributed delay over a finite or infinite interval, are considered. Sufficient conditions have been obtained for the global exponential stability of a unique point of equilibrium. A sufficient condition is found for the existence of a periodic solution for a class of Hopfield-type neural networks with bounded distributed delays and impulses in the integral form. A delayed Hopfield neural network is considered. Neural networks of neutral type are also considered. Sufficient conditions for existence and global asymptotic stability of a unique equilibrium point are obtained. Discrete analogs of Hopfield-type additive neural networks with continuous time and impulses are formulated using the discretization method. The cases without delay, with discrete delays and with delays that are distributed over an infinite interval, are considered. Sufficient conditions have been obtained for global exponential stability to a unique equilibrium in all three cases. The global exponential periodicity of discrete Hopfield neural networks obtained from continuous Hopfield neural networks using the semi-discretization method is investigated. Hopfield complex neural network with time-varying delays and impulses is considered.

#### **5. Second-order impulse differential equations with nonlocal conditions**

Second order differential equations in Banach spaces are considered. The existence and uniqueness theorem of a mild and classical solution are proved. The results obtained summarize the results for a second order differential equation without impulse effect.

I do not know the candidate for the competition and I have no personal impressions of her.

The materials presented by the candidate are complete and detailed. They contain the necessary information required by law. My only note is in the design of the contributions. They are presented as a description of the contributions in each individual article. They should be more concise and generic.

## CONCLUSION

According to the presented documents, the candidate Assoc. Prof. Zlatinka Kovacheva fulfills all the requirements of the law and the Regulations to it and the Regulations for the specific requirements for acquiring academic degrees and occupying academic positions at BAS and IMI-BAS. I give a positive conclusion for the selection of Assoc. Prof. Zlatinka Kovacheva in the competition for the academic position of "Professor" in the professional field 4.6 "Informatics and Computer Science", scientific specialty "Informatics (Information Modeling)".

I propose that the Scientific Jury unanimously vote on a proposal to the Scientific Council of the Institute of Mathematics and Informatics at the Bulgarian Academy of Sciences to select Assoc. Prof. Zlatinka Kovacheva for the academic position "Professor" in the professional field 4.6 "Informatics and Computer Science", scientific specialty "Informatics (Information Modeling)".

01.04.2020