

REVIEWS

by **Ivan Kolev Koychev**, professor at the Faculty of Mathematics and Informatics at the Sofia University "St. Kliment Ohridski",

for the competition for the academic position of "Professor", for the needs of the Institute of Information and Communication Technologies (IICT) - BAS, in the professional field 4.6 Informatics and Computer Sciences, specialty "Informatics (Artificial Intelligence)", announced in SG no. 41 / 05.21.2019

In the announced competition for the academic position of "Professor", for the needs of IICT BAS as the only candidate participating **Assoc. Prof. Dr. Gennady Agre** from IICT BAS. The applicant has submitted a **complete set of documents** in accordance with the requirements of IV. Art. 9. (1) IICT required of candidates for participation in the competitions for academic positions "professor", which was presented to me.

He graduated the State University in St. Petersburg, Faculty of Mathematics and Mechanics - **Master** in Theoretical Mechanics. Self-governing doctoral studies with scientific adviser prof. Vasil Sgurev – **Doctor (Ph.D.)** in professional field 4.6 Informatics and Computer Science.

The submitted documents show **that the applicant meets the minimum requirements for candidates** to occupy the academic position of "professor" according to Article Art. 29.(1) of the ZRABRB, as follows:

1. Has a **Ph.D. degree**.
2. Has held the academic position of " **Associate Professor** " in the same scientific organization for more than five years; he was a part-time **lecturer** at Sofia University "St. Kl., Ohridski "and was **a member of scientific research teams**.
3. He has presented **publications in specialized journals**, equivalent to the monograph not repeat presented for acquiring educational and scientific degree "doctor" (Ph.D.) and for occupying the academic position "associate professor".
4. He has also submitted other original **research publications**.
5. Meets **the minimum national requirements** of art. 2b, para. 2 and 3 respectively of the requirements of art. 2b, para. 5.
6. There is no legal plagiarism proven in scientific works

Report presented by Dr. Gennady Agre on the fulfillment of the minimum national and specific requirements of IICT-BAS for occupation of the academic position of "Professor" in professional direction 4.6. Informatics and Computer Science, direction Computer Science (AI)

is true. It shows that the candidate **fulfills, as some of them, significantly exceeds, the minimum requirements** of IICT-BAS for occupying the academic position of "professor".

It also meets Art. 2., Vol. 5. of the BAS Regulations : "The candidates for the academic position of "professor" have a clearly defined scientific subject in which they are leading researchers". D-r Agre is **a leading specialist internationally recognized in the field of Artificial Intelligence**, in particular: methods for knowledge representation, reasoning and Machine Learning. He has extensive experience in applying them in the fields of semantic technology, education and humanities. Evidences for this are his **publications in prestigious international journals with hundreds of citations** and his participation in **many international projects**.

He is the author and co-author of more than 110 **publications** in Bulgarian and international magazines and series. He is the author of **2book chapters**, one of which is published by the prestigious publishing house The MIT Press, Cambridge, Massachusetts, USA. The total number of **citations** noted by mid-July 2019 is: over 1020 in Google Scholar; over 380 in Scopus; over 200 in WoS.

He has participated in 10 international and 5 national **projects**, in many of which he has played a **leading role**. He is also **participate in the governing bodies of BAS**, as well as he participate in **expert bodies of science and higher education** in Bulgaria.

In the publications presented for the competition, the original scientific and applied **contributions** of Dr. Gennady Agre can be summarized in the following three directions:

- Semantic Web Services (SWS)

In this area, the applicant's contributions are related to the automation of the process of creating, maintaining and executing applications based on Web services through the application of semantic technologies. His main idea is to formulate and use formal descriptions with well-defined semantics to describe services, which helps solve some fundamental problems associated with service design, such as interaction between services, their discovery, "choreography" and "orchestration".

Dr. Gennady Agre's work in this area is related to his participation in a European research project under FP6 FP6 / 2002 / IST / 2. INFRAWEBs - Intelligent Framework for Generating Open (Adaptable) Development Platforms for Web Service Enabled Applications Using Semantic Web Technologies, Distributed Support Units and Multi-Agent Systems (2004-2007). In the project, Prof. Agre was the main developer of two key components for the project: a module for the dynamic composition of semantic Web services; and a module for constructing descriptions of SWS, using Web Service Modeling Ontology (WSMO). In addition, Dr. Agre was the main ideologist and creator of the conceptual architecture of the INFRAWEBs environment, integrating a logical approach with case-based reasoning.

The original scientific and applied achievements of Dr. Gennady Agre in the field of semantic web services are as follows:

- **Development of the overall architecture of INFRAWEBES environment for semantic integration of web services.** Architecture offers a new approach to creating and maintaining semantic web services. It also supports applications built on them, offering opportunities for integrating them based on logical reasoning and cas-based reasoning. The specific idea is to use case-based reasoning to quickly find approximate solutions, which are then refined through logical reasoning (Publications Nos. 2, 4, 5).
- **Development and implementation of an original, data-driven approach for dynamically composing semantic web services using ontology to model web services.** In this approach, the process of finding the right combination of services is guided by the real-time decomposition of a given goal into sub-goals and the discovery of existing services capable of meeting those sub-goals (Publications Nos. 4 and 5, and publication No 24 of Annex 1). The approach is noted as the only fully automated functional approach for dynamically composing semantic services described in the WSDL language that is practically implemented¹.
- **Development and implementation of INFRAWEBES Designer - a graphical environment for creating, describing and integrating Internet services.** The work is based on the WSMO and is intended for suppliers of semantic services and applications and requires them no prior knowledge of the language to describe WSML. The environment facilitates the task of creating WSML objects, which is usually quite complex and requires expertise in both the WSMO model and the logical language of WSML (publications No 1, 3).

The creation of an integrated INFRAWEBES environment and specialized tools for working with semantic services (among which INFRAWEBES Designer) has been recognized as one of the important achievements of the project, which has the potential to more easily adapt semantic internet services technologies on a global scale².

- Technologically Enhanced Learning (TEL)

The research conducted by Assoc. Prof. Agre in the field of TEL is directed in two main directions: 1) development of methods for the use of semantic technologies for the development of TEL applications (publications 6-13) and 2) improvement of methods for TEL through introduction on game elements (Publications 14-18).

The first publications are related to the work on the large research project No. D-002-189 SINUS: Semantic Technologies for Internet Services and Technologically Supported

¹ Klusch M. (2008) Semantic Web Service Coordination. In : Schumacher M., Schuldt H., Helin H. (eds) CASCOM: Intelligent Service Coordination in the Semantic Web. Whitestein Series in Software Agent Technologies and Autonomic Computing. Birkhäuser Basel.

² Gerardo Canfora, Erica van de Stadt. Evaluation report on the project Contract Nr. 511723 INFRAWEBES (March 8, 2007).

Education (2009-2012) funded by the NSF, which included two other partners besides IICT-BAS. Dr. Agre was the head of the team of IICT-BAS and the coordinator of the whole project.

In particular, the scientific and applied contributions of Dr. Agre in this direction are:

- ***Development and implementation of an environment for the development of TEL applications in humanitarian fields.*** The environment is based on semantic technologies and consists of three layers - *a storage layer* containing repositories for storing heterogeneous subject area knowledge and pedagogical knowledge; *a tool layer* containing a set of tools for processing different types of knowledge, and *an intermediate layer* implemented as an advanced search engine, making all the necessary links between the tools and the repositories.
- ***Development and implementation of an original approach for using various digital libraries*** that allows to keep intact the content, annotations and access method to use educational units and at the same time adds the ability to richer semantic access to information objects, using of additional descriptive features defined in specialized ontologies.

Research related to the possibilities of using the game elements (gamification) in TEL were carried out in collaboration with prof. Darina Dicheva and prof. Hristo Dichev from the State University in Winston Salem, USA, within the European project FP7-REGPOT-2012-2013-1 Grant Agreement: 316087 AComIn - Advanced Computing for Innovation (2012-2016).

- ***With the lead of Prof. Darina Dicheva, a system of classification indicators was developed to evaluate the degree of use of game elements in existing TSE applications.*** The system was applied to analyze published studies of applications of game elements in education, which helped to clarify both the main directions of these studies and the main obstacles to the implementation of this approach.

A related publication (№ 16) is one of the major publications on the use of game elements in education, collecting over 630 citations at Google Scholar, over 270 citations in Scopus, and over 160 citations in WoS by the end of June 2019.

- Machine Learning (ML) and Data Mining (DM)

Studies of Dr. Agre in this area are related to the development of new and improvement of existing algorithms for Instance-Based Machine Learning (publications № 23 and 27), and with the application of different methods from ML to solving problems in such subject areas as archeology (publication No. 19), image analysis (publications Nos. 20 and 21), analysis of educational data (publications Nos. 25 and 26), nutrition (publications Nos. 22 and 23)) and natural language processing (Publications Nos. 28 and 29). Publications No. 22 and 23 reflect the work on research project No. 04-152 "Expert Advisory System for Healthy and Dietary Nutrition", funded by the National Innovation Fund (2007-2010), in which Dr. Agre was the project leader. Publications Nos 25 and 26 are the result of the work of a team carried out in

the framework of a European project under the 7th Framework Program AComIn - Advanced Computing for Innovation (2012-2016). In particular, the original scientific and applied achievements of Assoc. Prof. Agre in the field of ML and DM are:

- **Developed a new feature selection method that is appropriate for case-based classification methods.** The choice is based on an evaluation of the quality of the features obtained by the ReliefF algorithm, which is applied to an orthogonal feature space, obtained after applying the principal component analysis method. The resulting weights are interpreted as values proportional to a number of explained changes in the concept descriptions (Publication No. 27).
- **Developed a new approach to solve the all-words sense disambiguation problem and implement it as a flexible WSD Studio software system.** The developed approach allows to avoid the need to build multiple classifiers specializing in resolving ambiguity of a single word. The approach uses a specific compressed data representation that allows to train more general classifiers, which provide a high accuracy of prediction (publications Nos. 28 and 29).
- Development and implementation of an expert **system for healthy and dietary nutrition**, which allows the identification and classification of foods based on their nutritional content (Publications Nos. 22 and 24).

Assoc. Prof. Agre has participated in dozens of **program committees** of international conferences and is the main **organizer** of the last 4 issues of **AIMSA** - International Conference on Artificial Intelligence: Methodology, Systems, Applications - proceedings are published in LNCS - Springer. He has also a significant **editorial work** on scholarly journals and conference papers, for example: he is a deputy editor-in-chief of a journal with SJR; He is the co-editor of several conference proceeding published in LNCS - Springer.

Assoc. Prof. Agre also has teaching commitments - teaching **courses** in Machine Learning (2002 - 2019) and Data Mining (2002 - 2019) for Master students at the Faculty of Mathematics and Informatics, Sofia University, and before a course in Case-based Reasoning (1998 - 2002). He has supervised **17 MSc** graduates and **3 PhD** students. He is the co-author of the **textbook** - G. Agre, Z. Markov and D. Dochev. *Introduction to Machine Learning*. Softech, Sofia 2001, 291 pages.

CONCLUSION

The documents presented by the applicant **meet all** the requirements of the Law for the Development of the Academic Staff in the Republic of Bulgaria, the Rules for the implementation of that Law and the related regulations of BAS and IICT-BAS. Assoc. Agre **fulfills the minimum requirements of IICT-BAS for occupying the academic position of "Professor"**. He is a **leading specialist with international recognition in the field of**

artificial intelligence. The scientific and applied contributions are original and significant. **Publications in reputable international issuers** with **hundreds of citations** and participation in numerous international projects are in support of this statement.

After examining the submitted competition documents and scientific works, analyzing their significance and contained in their scientific and applied contributions, I am giving a **positive assessment** and I am suggesting to the panel to prepare a report-proposal to the Scientific committee of IKT- BAS **for the selection of the candidate Associate Professor Gennady Agre of the academic position "Professor"** in the professional field 4.6 Informatics and Computer Sciences, specialty "Informatics (Artificial Intelligence)", announced in SG no. 41 / 21.5.2019.

09/10/2019,

Sofia

Signature:

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/Prof. Dr. Ivan Koychev/