OPINION

For a competition for the academic position "Professor" SN 87/15.10. 2024 .
With candidate: **Assoc. Prof. PhD Irina Aleksandrovna Radeva**

From Prof. DSc Krasimira Stoilova – Institute of Information and Communication Technologies (IICT) – Bulgarian Academy of Sciences (BAS)

By order № 312 from 13.12.2024 г. of the Director of IICT - BAS, issued on the basis of a decision of the Scientific Council of IICT, protocol №12 from 27.11.2024 I have been appointed as a member of the scientific jury for a competition to occupy the academic position of "Professor" in the field of higher education 4. Natural sciences, mathematics and computer science; professional direction 4.6 „Informatics and Computer Sciences", scientific specialty „Informatics (Blockchain technologies and models)" for the needs of a section „Intelligent Systems" of IICT - BAS. Only one candidate submitted documents for the announced competition - Assoc. Prof. PhD Irina Aleksandrovna Radeva.

1. General description of the presented materials

Assoc. Prof. I. Radeva has submitted all necessary materials for participation in the competition according to Art. 10(1) of the Regulations on the specific conditions for acquiring scientific degrees and for occupying academic positions at IICT-BAS.

Associate Professor Irna Radeva has been a doctor since 2012 and an associate professor since 2018.

An official note is presented regarding the total work experience, which is 35 years, of which she worked as an associate professor for 6 years and 5 months.

All 28 scientific publications submitted are after the competition for "associate professor", so there are no repetitions of results from previous procedures. The majority of publications are in English. One independent publication is presented [18].

2. General characteristics of the scientific and scientific-applied activity

The scientific interests of Assoc. Prof. I. Radeva are in two main areas according to the publications for the competition:

Blockchain Technologies and
Risk Management Models

A blockchain is a distributed database (or digital ledger) for storing information in sequentially linked blocks that contain cryptographically signed transactions. Each block is linked to the previous one through a cryptographic function, which makes it impossible to change historical data and ensures the system is resistant to manipulation. Blockchain oracles are systems of network agents that bring external information to the blockchain network and provide it to smart contracts. They enable interaction between real-world data and the blockchain infrastructure through a set of verification protocols. A smart contract is a program code for automatically executing transactions in a blockchain environment when predefined conditions are met. It is a computer protocol that executes the terms of the contract without the need for an intermediary. These basic technologies and concepts have been researched, further developed, and applied in practice by the candidate.

3. Analysis of scientific and applied scientific achievements according to the materials

SCIENTIFIC CONTRIBUTIONS

Synthesis of models and approaches based on Blockchain technologies

A conceptual model has been developed for integrating an interface platform for storing information about research results via a blockchain network for reliability purposes [8].

An approach for managing scientific data for intelligent crop cultivation is proposed, integrating two technologies – blockchain and a distributed file system [15]. Such an approach allows users to exchange data in a secure, traceable, decentralized manner. The distributed file system allows for working with large files that are by definition not supported by blockchains, thus providing an environment in which manufacturers, researchers, and developers can share relevant information. The advantage is increased reliability in sharing and exchanging research and development results; improved management and control over uploading and downloading raw data and files for analysis; transparency of actions and tracking of activities related to file exchange on the platform network.

Multi-criteria blockchain software selection under uncertainty

A group decision-making approach has been developed on blockchain software that integrates fuzzy evaluation methods and classical multi-criteria methods [9]. Main features of the most widely used blockchain software in agriculture are presented [9]. A fuzzy set evaluation system with adaptive weights is proposed for the following indicators: functionality, implementation, support, training, and user ratings of blockchain software.

Automated evaluation with Natural Language Processing (NLP) metrics of Retrieval-Augmented Generation (RAG) for open-source large language models (LLMs)

The responses generated by three open source Large Language Models (LLMs): Mistral:7b, Llama2:7b and Orca2:7b are evaluated in the context of Retrieval-Augmented Generation (RAG). Natural Language Processing metrics are applied: METEOR, Rouge-1.f, Rouge-l.f, BLEU, Laplace Perplexity, Lidstone Perplexity, Cosine similarity, Pearson correlation, F1 score [25]. Similarity thresholds that maximize efficiency in multiple Natural Language Processing have been defined. The web-based application PaSSER was used to automate the testing and analysis process. RAG technology is integrated with blockchain in connection with testing of large language models (LLMs) to improve data security and verifiability [26].

SCIENTIFIC APPLIED CONTRIBUTIONS

A knowledge base architecture in the field of smart crop farming has been compiled [14]. The proposed architecture includes three layers – an ontology layer for representing general domain knowledge, a database layer for dynamic data from various measurements for assessing characteristics and factors affecting plants, and an application layer consisting of intelligent components for connecting the two knowledge layers.

Risk management models and procedures

The main negative and unidentified impacts of the implementation of 17 new technologies under the auspices of Industry 4.0 are summarized according to literature data. The risk factors are grouped into eight general categories related to issues of personal data use and data security, changing labor markets, fragmentation, responsibility and accountability, ecology, ecosystems and ethics, changes in income/expenditure structures, and asset

ownership [2, 3, 6]. A model for evaluation and multi-criteria selection of risky technologies has been developed based on the quasi-multi-criteria SIGMA model [2].

The guidelines and role of the most significant and used risk management standards are presented, the general aspects of the evolution of risk management, enterprise risk management and integrated enterprise risk management are analyzed, and an extension of integrated enterprise risk management to the concept of global enterprise risk management is proposed, where the emphasis is on the risk of Industry 4.0 and the implementation of artificial intelligence in cyber-physical systems [13].

It is shown how global enterprise risk, including Industry 4.0 risks, can be used to make risk management decisions in organizations implementing blockchain [11]. The quasi-multicriteria SIGMA algorithm was used to assess elements of the enterprise's global risk according to various risk tolerance criteria.

Models in smart agriculture with blockchain implementation

An approach is proposed to build a supply chain model for smart agriculture based on blockchain technology [10, 17, 18]. The model aims to facilitate traceability of origin, production, seed certification, interaction with regulatory authorities, logistics and financial services. A three-layer reference blockchain infrastructure and supply chain with five information channels, nine participants and smart contracts is presented. Examples of user account management, general descriptions of the main functionalities and selected parts of a smart contract are shown [17].

A TestApp prototype of a data exchange platform that integrates Antelope (formerly EOSIO - an open source blockchain protocol characterized by high transaction speed, flexibility, and scalability) and IPFS (Inter Planetary File System) has been presented [19, 28]. Such an approach allows for the exchange and management of larger amounts of data, data quality control, extraction and exchange of heterogeneous raw data, transparency of the origin and authorship of this data, and traceability of all operations performed through the platform network.

Stages, procedures and elements for an internal audit plan in organizations implementing blockchain technologies are proposed [12]. The research is further developed in [16], where a framework for auditing smart contracts is presented with a focus on security and vulnerability analysis for applications in data and information sharing platforms. Smart contract audit activities are systematized in 4 directions. A 5-step plan is proposed for auditing a smart contract for file exchange on a platform based on EOSIO/IPFS.

A decentralized application (dApp) for smart crop production data exchange (SCPDx) has been developed that integrates Antelope blockchain and IPFS infrastructure [23]. To ensure security and efficiency in user authorization and execution of blockchain transactions, a standard Anchor wallet is used to provide better protection for users' private keys.

An integration of two server-based blockchain oracles into a blockchain platform for data exchange in smart crop production via smart contracts is presented [22].

A framework is proposed for evaluating mechanisms for authentication and proof of events using smart contracts in a platform for information and data exchange in smart crop production [24]. Framework performance testing was performed to measure the platform's ability to process transactions efficiently and in a timely manner.

An open source web application has been developed for a blockchain platform for information and data exchange in smart crop production [21]. The platform architecture integrates Antelope blockchain and IPFS (Interplanetary File System) private networks, blockchain oracles, MariaDB SQL database, and a web server.

Blockchain wallets, classification and application in smart crop production are described in [20]. Blockchain wallets provide users with the ability to authenticate, authorize, and securely store their assets in a decentralized environment.

A summary of blockchain models in smart agriculture is included in the collective monograph [28]. It is emphasized that blockchain technology can lead to improvements in smart agriculture in several key areas: supply chain traceability; quality management; efficient resource management; certification and compliance; financial services; data management.

Other contributions

A personal tourist guide is presented that can generate virtual or real cultural routes [7]. The architecture consists of several intelligent agents that work with an ontology network and ambient network as a knowledge base to generate tourist routes.

I positively assess the candidate's scientific and applied scientific contributions in the research areas presented.

4. Citations

The candidate's publications have 140 citations, with all citing publications indexed in Scopus and/or Web of Science.

5. Fulfillment of minimum requirements and other activities

Assoc. Prof. Dr. Irina Radeva fulfills and exceeds 4 out of the 5 indicators of the Regulations on the specific conditions for acquiring scientific degrees and for occupying academic positions at IICT-BAS, the minimum requirements for the academic position of "professor". Requirements/performance for individual indicators is as follows: indicator A - 50/**50**; B - 100/**120**; Г – 260/**290**; D – 140/**840**; E – 150/**515**.

Assoc. Prof. Dr. I. Radeva is the head of 7 projects and has participated in 22 projects according to the attached Report on the fulfillment of the minimum requirements for a "professor". Evidence should be attached here.

I highly appreciate the results of the candidate's research regarding information support for smart agriculture through the application of blockchain technologies and recommend further work to provide services related to the receipt, storage, processing and analysis of data.

Assoc. Prof. Dr. Irina Radeva has active research and applied science activities, characterizing her as a highly qualified scientist with international prestige.

Conclusion. Based on the presented materials, the scientific and scientific-applied contributions, as well as the comprehensive assessment of the other indicators of the competition, **I give a positive assessment** and **recommend to the Honorable Jury** to propose to the Scientific Council of IICT-BAS **to elect Assoc. Prof. Dr. Irina Radeva** for the academic position of "**Professor**" for the needs of the "Intelligent Systems" department at IICT-BAS, professional field 4.6 "Informatics and Computer Science", specialty "Informatics (Blockchain Technologies and Models)" for the needs of a section „Intelligent Systems" of IICT - BAS.

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