Transilvania University of Brașov
INTERDISCIPLINARY DOCTORAL SCHOOL

ADMISSION TO DOCTORAL STUDIES Session September 2025

Field of doctoral studies: Computers and Information Technology
Doctoral supervisor: Prof. Dr. Razvan Andonie

TOPICS FOR THE ADMISSION TO DOCTORAL STUDIES

TOPIC 1: *Neuro-symbolic Models for Data-and Knowledge-Driven AI*

Contents / Main aspects to be considered - *to be adapted/ completed/ deleted*

AI has historically been dominated by two paradigms: symbolism and connectionism. Neuro-symbolic (NeSy) AI is a type of artificial intelligence that integrates neural and symbolic AI architectures to address the weaknesses of each, providing a robust AI capable of reasoning, learning, and cognitive modeling. NeSy is widely recognized as an enabler of the next generation of AI. NeSy essentially looks for the integration of two fundamental cognitive abilities: learning (the ability to learn from experience), and reasoning (the ability to reason from what has been learned), so as to exploit the major strengths and circumvent the inherent deficiencies of the two paradigms. Although a strong NeSy system is still far from achieved, given the significant progress in AI over the past decade, we believe NeSy is a promising direction for the development of the next generation of AI. The research direction of this project includes developing novel NeSy computational methods with applications. Key research questions to be addressed are:

- What is the best way to integrate neural and symbolic architectures?
- How should symbolic structures be represented within neural networks and extracted from them?
- How should common-sense knowledge be learned and reasoned about?
- How can abstract knowledge that is hard to encode logically be handled?

Recommended bibliography:

Wang, Wenguan, Yi Yang, and Fei Wu. "Towards data-and knowledge-driven artificial intelligence: A survey on neuro-symbolic computing." *arXiv preprint arXiv:2210.15889* (2022). https://arxiv.org/abs/2210.15889

Zhang, Xin, and Victor S. Sheng. "Neuro-Symbolic AI: Explainability, Challenges, and Future Trends." *arXiv preprint arXiv:2411.04383* (2024). https://arxiv.org/abs/2411.04383

Prerequisites / Remarks: *to be adapted/ completed/ deleted*

X Scientific Doctorate (full-time only) ☐ Professional Doctorate (full-time or part-time)
☐ without tuition fee (state budget funded) X with tuition fee or with funding from other sources than the state budget

TOPIC 2: *suggested title*
Contents / Main aspects to be considered - *to be adapted/ completed/ deleted*
Recommended bibliography:
Prerequisites / Remarks: *to be adapted/ completed/ deleted*
Scientific Doctorate (full-time only) Professional Doctorate (full-time or part-time)
without tuition fee (state budget funded) with tuition fee or with funding from other sources than the state budget

Doctoral supervisor,

Prof. Dr. Razvan Andonie

Signature

Coordinator of the field of doctoral studies,

Prof. Dr. eng. Sorin-Aurel Moraru

Signature