Doctoral School of Information and Biomedical Technologies
Polish Academy of Sciences (TIB PAN)

SUBJECT: **Formal methods for large-scale system dynamics. Between attractors, strategies, and quantum protocols (with help of AI)**

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DESCRIPTION:
The project aims at the development of novel methods of automated verification and formal analysis of complex systems. These can be multi-agent systems, consisting of humans, technological infrastructure, and AI components, but also biological systems where multiple biological agents interact, or gene structures interact to produce a phenom.

We will explore the connections between AI, formal verification of intelligent agents, and algorithmic analysis of complex biological systems. The formal methodology is expected to build on suitable extensions of temporal and strategic logic, interpreted in asynchronous transition networks. In particular, we plan to:

- Leverage logic-based methods for specification and verification of multi-agent systems to systematically expand the scope of attractor analysis in synchronous and asynchronous biological networks;

- Adapt Machine Learning-based methods of attractor analysis in biological systems to large-scale verification of multi-agent interaction;

- Apply the resulting techniques to specify and verify selected properties of post-quantum security.

PROFILE OF THE CANDIDATE:
The candidate is required to have a strong background in mathematical logic and theoretical computer science, as well as programming skills (C++, Java, Python). Some knowledge in the areas of formal methods, verification techniques, and machine learning/artificial intelligence is

expected. We are looking for candidates characterised by proactive approach to solving scientific problems and issues. The candidates should also have good communication skills and good command of oral and written English.