Research area:	Semantic technologies and machine learning in development of intelligent systems
Ph.D. Advisers:	dr hab. Maria Ganzha https://scholar.google.pl/citations?user=y9mZCW8AAAAJ dr hab. Marcin Paprzycki https://scholar.google.pl/citations?user=OWSryNQAAAAJ
Ph.D. Co-advisers:	dr Katarzyna Wasielewska-Michniewska https://scholar.google.pl/citations?user=ZYmjvYMAAAAJ dr Wiesław Pawłowski https://scholar.google.pl/citations?user=mr7fct0AAAAJ
Institution:	Systems Research Institute Polish Academy of Sciences
Discipline:	Technical Computer Science and Telecommunication
Form of recruitment:	talk with the candidates
Number of candidates:	2

Description: Recent years have seen second return of, broadly understood, “connectionist AI” (e.g. Convolutional Neural Networks), as the poster child approach to development of intelligent systems. However, it can be noticed that the leaders in the field have already realized that, for a variety of reasons, “connectionist approaches”, as we know them (in 2020), are reaching their limits. In particular, while extremely impressive in solving specific problems in narrow domains, they seem to be missing capabilities that were usually associated with symbolic processing (e.g. direct application and explicit interpretability of rules). Here, recent calls for proposals issued by the European Commission (see, below) show return of interest in semantic technologies.

The aim of the proposed research will be to consider possibilities brought by combination of (mainly connectionist) machine learning (ML) and semantic technologies for development of intelligent systems. In particular the following areas can be investigated (separately, or jointly; this list is not exhaustive): (a) interplay between semantic layer and ML layer of a data processing pipeline; (b) reasoning and learning from big-data-scale semantic lakes and linked open data; (c) combination of symbolic and statistical ML models in the context of semantic information processing; (d) introduction of semantic methods into semi-automatic feature extraction for ML; (e) introduction of ML into a semantic data fabric; (f) explainability of deep semantic learning.

European context:
https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/ict-40-20201
https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/dt-nmbp-39-2020

Literature (illustrative samples):
1. Hofmann, Thomas. "Probabilistic latent semantic analysis." arXiv preprint arXiv:1301.6705 (2013).
2. Zhuge, Hai. "Interactive semantics." Artificial Intelligence 174.2 (2010): 190-204.
3. Flasiński, Mariusz. "Symbolic Artificial Intelligence." Introduction to Artificial Intelligence. Springer, Cham, (2016).
4. Gandon, Fabien. Distributed Artificial Intelligence and Knowledge Management: ontologies and multi-agent systems for a corporate semantic web. Diss. (2002).
5. Aerts, Diederik, and Marek Czachor. "Quantum aspects of semantic analysis and symbolic artificial intelligence." Journal of Physics A: Mathematical and General 37.12 (2004).
6. Carbonell, Jaime R., and Allan M. Collins. "Natural semantics in artificial intelligence." American Journal of Computational Linguistics (1974).
7. Honavar, Vasant. "Symbolic artificial intelligence and numeric artificial neural networks: towards a resolution of the dichotomy." Computational Architectures integrating Neural and Symbolic Processes. Springer, Boston, (1995).
8. Will Knight, Two rival AI approaches combine to let machines learn about the world like a child, MIT Technology Review, April 8, 2019