Supervisor Expression of Interest
MSCA - Marie Sklodowska Curie Action - (PF) Postdoctoral Fellowship 2024

Supervisor name: Giovanni Valente

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Department Name: Department of Mathematics Francesco Brioschi (DMAT)

Research topic: Analogical Reasoning in AI: Philosophical Perspectives

SH4_13 Epistemology, logic, philosophy of science

MSCA-PF Research Area Panels:
- ☐ ECO_Economic Sciences
- ☐ ENG_Information Science and Engineering
- ☐ ENV_Environmental and Geosciences
- ☐ LIF_Life Sciences
- ☐ MAT_Mathematics
- ☐ PHY_Physics
- X SOC_Social Sciences and Humanities
- ☐ CHE_Chemistry

Brief description of the Department and Research Group (including URL if applicable):

The project will be carried out in the Department of Mathematics, which hosts a growing number of research activities in philosophy of science. There, the successful candidate will also have the opportunity to interact with practicing mathematicians, as well as with experts on science communication based in the laboratory EFFEDIESSE. Moreover, she\he will join the inter-departmental group META (http://www.meta.polimi.it/) devoted to philosophy and sociology of science and technology, so as to work in close connection with its international partners, such as the Irvine-London-Munich-PoliMi-Salzburg Network and the IDEA League Ethics Working Group.

TITLE of the project: Analogical Reasoning in AI: Philosophical Perspectives

Brief project description:

Analogical thinking is recognized as a useful tool in problem solving, especially in the context of scientific discovery. Based on similarities between the properties of different systems, analogies suggest that what is true for one system is also be true for the other. Analogical reasoning are a central element in human thinking, and as such it has been extensively studied by philosophers as well as researchers in Artificial Intelligence (AI). Since analogical inferences are not deductively valid, their fruitfulness is in need of explanation. A widely shared view in philosophy of science is that analogies cannot be formalized and should be explained on a case-by-case basis. At the same time, however, in AI analogical reasoning is formally implemented in the form of analogical proportions (i.e. statements of the form "a is to b as c is to d", like "cow is to calf as mare is to foal"), hereon APs, which are fruitfully applied in various domains, such as natural language processing, image processing, and machine learning. This raises many open philosophical questions.

The aim of the present project is to analyse successful instances of analogical reasoning in AI from a philosophical viewpoint, thereby contributing both to the philosophical understanding of analogies and to the assessment of the fruitfulness of APs in AI applications. Questions that will be addressed are for example: What is exactly the difference between using APs for data-extension and analogical reasoning for scientific discovery? What are the relevant properties that lead to useful analogies? Does the successful application of APs depend on the way they are modelled (logical, algebraic, complexity-based)? Or on the approach to classification? Can APs help one identify biases in data?

By bringing together the analytical methods of contemporary philosophy of science and the relevant work of practicing computer scientists and AI developers, this project proposes to deal with epistemological and methodological problems concerning analogical reasoning applied in present-day AI. For this purpose, when carrying out the project at PoliMi, the successful candidate will interact with the philosophers of science and technology operating within the inter-departmental unit of study META, as well as with science scholars based in the Department of Mathematics. Moreover, the laboratory EFFEDIESSE devoted to the pedagogy of mathematics and communication of science will provide technical resources to disseminate the results of the research project in the form of public lectures and training courses designed for high-school teachers.