

PROJECT / Beyond features: similarity-based pattern analysis and recognition

SIMBAD

Main Objective:

The challenge of automatic pattern analysis and recognition (or machine learning) is to develop computational methods which learn to distinguish among a number of classes from examples, with a view to endow artificial systems with the ability to improve their own performance in the light of new external stimuli. This ability is instrumental in building next-generation artificial cognitive systems which, as opposed to traditional machine or computer systems, can be characterized as systems which cope with novel or indeterminate situations, which aim to achieve general goals as opposed to solving specific problems, and which integrate capabilities normally associated with people or animals. The socio-economic implications of this scientific endeavor are enormous, as it will have applications in a wide variety of real-world scenarios ranging from industrial manufacturing to vehicle control and traffic safety, to remote and on-site (environmental) sensing and monitoring, and to medical diagnostics and therapeutics. This project aims at bringing to full maturation a paradigm shift that is currently just emerging within the pattern recognition domain, where researchers are becoming increasingly aware of the importance of similarity information per se, as opposed to the classical feature-based approach. Indeed, the notion of similarity has long been recognized to lie at the very heart of human cognitive processes and can be considered as a connection between perception and higher-level knowledge, a crucial factor in the process of human recognition and categorization. We shall undertake a thorough study of several aspects of purely similarity-based pattern recognition methods, from the theoretical, computational, and applicative perspective. We aim at covering a wide range of problems and perspectives, considering both supervised and unsupervised learning paradigms, generative and discriminative models, and our interest will range from purely theoretical problems to real-world practical applications. We shall apply our algorithms to challenging biomedical problems that lend themselves particularly well to similarity-based approaches, namely, to the analysis of tissue micro-array images of renal cell carcinoma and to magnetic resonance brain imaging for the diagnosis of mental illness.



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Team: [Mário Alexandre Teles de Figueiredo](#), [Ana Luisa Nobre Fred](#), José David Pereira Coutinho Gomes Antão

Groups: [Pattern and Image Analysis – Lx](#)

Partners: Eidgenoessische Technische Hochschule Zurich, Switzerland, Technische Universiteit Delft, Netherlands, Università Ca' Foscari di Venezia, Italy, Università degli Studi di Verona, Italy, University of York, United Kingdom

Local Coordinator: [Mário Alexandre Teles de Figueiredo](#)
