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Topological machine learning and its applications to Raman spectroscopy.

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The advent of machine and deep learning has driven major advances in computer vision and data analysis, enabling a shift from handcrafted features to automatic extraction of meaningful features through representation learning. At the same time, topological invariants provide computable shape descriptors well-suited for distinguishing complex structures, though when applied to real-world data, these descriptors might seem too rigid. Persistent homology (PH), overcomes this limitation by enabling intrinsically multiscale analysis. In joint work with Davide Moroni e and Francesco Conti, we combined PH and machine learning to develop a Topological Machine Learning (TML) pipeline, which has demonstrated promising results in challenging classification tasks.

This talk will describe the synergy between persistent homology and machine learning, and survey recent trends in TML. We will present applications to Raman spectroscopy data, with a focus on their potential impact in the medical domain.

Primary author: Dr PASCALI, Maria Antonietta (CNR –Pisa)

Presenter: Dr PASCALI, Maria Antonietta (CNR –Pisa)