In machine learning, very powerful and efficient methods have been proposed when data are represented by flat and fixed-width real vectors, even when heavily corrupted by noise. Neural networks, support vector machines and statistical methods are well known and widely used techniques. All of them share many successful stories in real-life problems, a well established theoretical background, and many journals and conferences devoted to explore possible refinements and applications.

Unfortunately, in many relevant applications, data are not naturally expressed in terms of flat vectors. More expressive data structures, as trees or graphs, often nicely capture essential properties of the problem at hand, simplifying its mathematical representation and paving the way for its solution. Also, the features characterizing the input vectors are quantitative, i.e. numerical in nature, but features having imprecise or incomplete specification are usually either ignored or discarded from the design and test sets. The concept of Zadeh's fuzzy set theory can be introduced into the machine learning process to cope with impreciseness arising from various sources. For example, it may become convenient to use linguistic variables and hedges (small, medium, high, very, more and less, etc.) in order to describe the feature information. Again, uncertainty in classification may arise from the overlapping nature of classes; realistically speaking, the feature vector characterizing a specific pattern can and should be allowed to have degrees of membership in more than one class. The research activity concerns the design of neuro-fuzzy and kernels models for processing structured data. The studies relating the insertion of fuzzy rule-based domain knowledge and hence the fuzzy automaton state transitions into neural or kernel models should provide two benefits: (i) improving generalization to new instances and (ii) simplifying learning. The applications include 2D e 3D object recognition.