

Objective

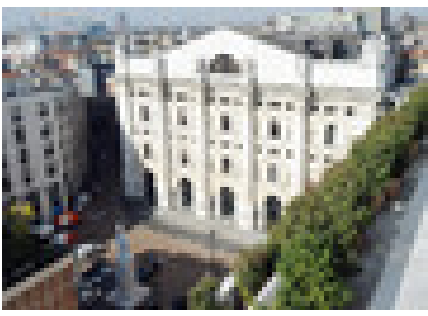
The project's goal is to apply advanced Machine Learning methodologies, mainly based on SVMs, and the related effective numerical methods for the solution of the underlying optimization problem. The analysis aims to identify the most suitable solution strategies for a given application context, or for a specific problem instance, by exploiting the characteristics of its mathematical model. In addition to the binary classification, also multiclass and (nonlinear) regression problems can be considered. The algorithmic study is followed by a code prototyping, with the possible development of a scalar or high-performance software, tailored to apply the studied strategies to the particular needs for the user. The research group makes its skills on Numerical Analysis, Numerical Optimization, scalar and concurrent programming available to the project.

Machine Learning

- Process of **inductive inference**:
 - ✓ Observe a phenomenon
 - ✓ Make a model
 - ✓ Make predictions
- A very **general scheme** largely applied in many natural sciences
- Machine learning aim is to make this process **automatic**!

Example 1: text categorization

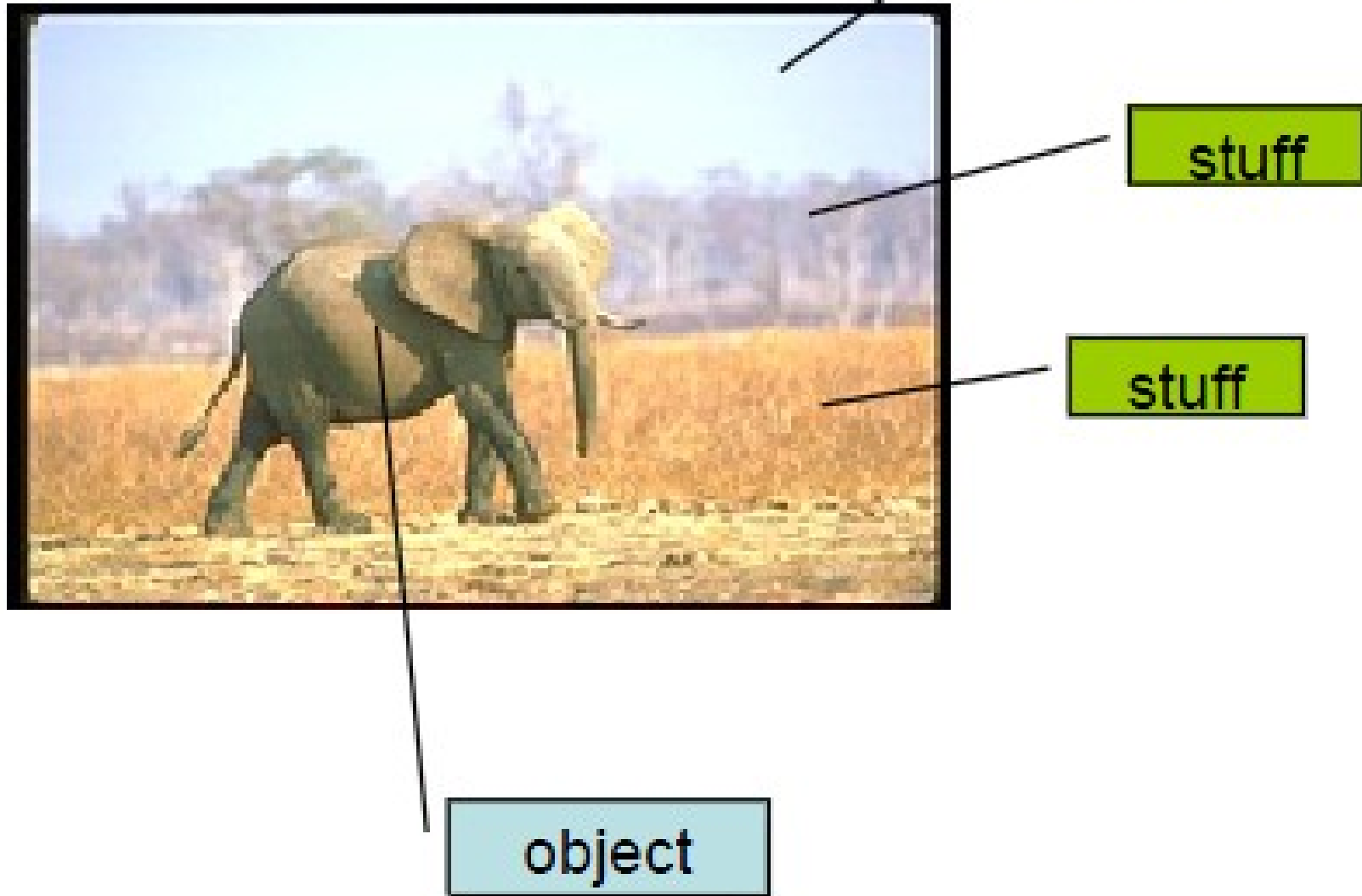
News from www.ansa.it, 10 may 2011

Economy	17:40 10 MAG	Borsa Milano:chiude in rialzo, +1,47%	
World	10:27 10 MAG	Will e Kate partiti per luna di miele	
Tourism	11:25 10 MAG	Bandiere blu, promosse 233 spiagge	
Sport	22:35 10 MAG	Giro: si ritira il team Leopard Trek	

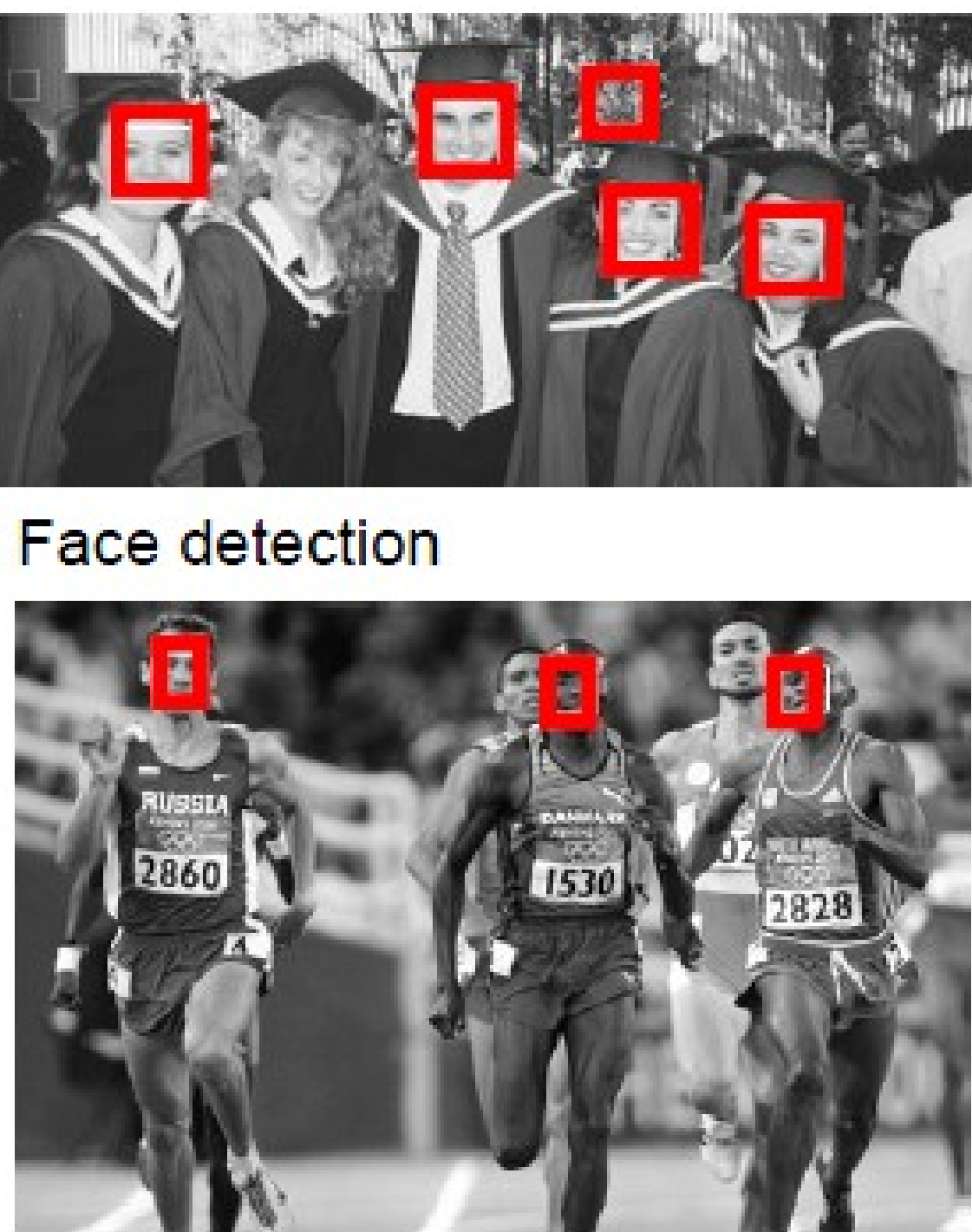
- Retrieval of information in large scale databases (e.g. Ansa, Reuters, ...)
- Data mining (data structure retrieval)
- Automatic filtering (e.g. antispam)
- Check the access to informative systems

Example 2: image classification

Automatic labelling



Face detection



- Optical Character Recognition (OCR) - Systems for automatic reading of printed or handwritten documents
- Image classification/retrieval in databases and in search engines for the web
- Identity check from face images or fingerprints

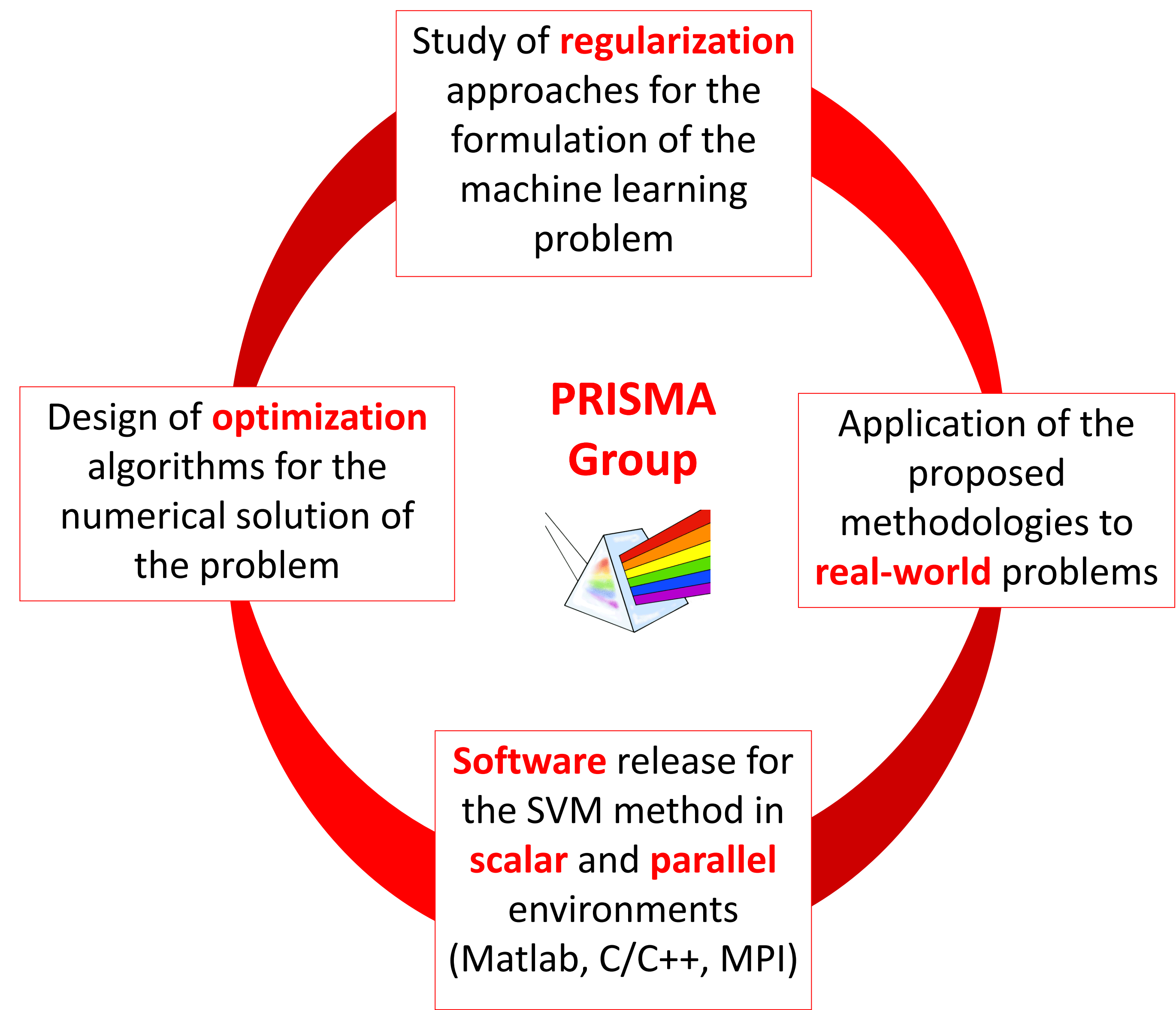
Other examples

- Time series prediction (finance, weather forecast, . . .)
- Classification of microarray gene expression data and other genetics applications
- Brain activity interpretation through functional Magnetic Resonance Imaging – fMRI – data (predict what the observer is viewing/perceiving starting from the knowledge of the fMRI data of its brain)



Our contributions

State of the art



Expected results

- Identification of an appropriate Machine Learning methodology for the user's particular context of interest and definition of the related algorithms
- Implementation of the studied algorithms in a prototypical code
- Numerical experimentation on benchmark datasets and real data provided by the user

Contacts

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