

# Design of distributed optimization toolboxes for learning and control

Progettazione di toolbox di ottimizzazione distribuita per apprendimento e controllo

## Piano di attività per Assegno di Ricerca

### RESEARCH PROJECT

#### 1. Context

In modern smart factories, several interesting complex tasks rely on the formulation and numerical solution of large-scale optimization problems. Solving these large-scale problems, represents an important and timely problem involving several challenges as privacy preserving and scalability. A new computing frontier involves design methods and toolboxes in which computing agents can solve decision, learning and control problems by performing local computation and communication via distributed optimization approaches.

#### 2. Research Activity (Attività di ricerca)

*The research activity will focus on the study and development of algorithmic routines and software tools to realize a distributed middleware platform allowing different computing units to implement distributed optimization algorithms in a multi-node processing platform. Starting from available research-oriented software toolboxes, as Disropt and ChoiRbot, the candidate will study how to design communication, computation and algorithmic protocols to solve optimization problems in a distributed multi-node platform for learning, decision and control problems, e.g., for machine learning or robotic fleet management. The developed tools will be applied to specific examples with synthetic and possibly experimental data.*

L'attività di ricerca mirerà a studiare e sviluppare procedure algoritmiche e tool software per la realizzazione di una piattaforma "middleware" distribuita che permetta a diverse unità di calcolo di implementare algoritmi di ottimizzazione distribuita in una piattaforma di processing multi-nodo. Partendo da toolbox software per la ricerca, quali Disropt e ChoiRbot, il candidato studierà come progettare protocolli di calcolo, comunicazione e algoritmici per risolvere problemi di ottimizzazione in una piattaforma multi-nodo distribuita per problemi di apprendimento, decisione e controllo, e.g., per machine learning o per gestione di flotte robotiche. I tool sviluppati saranno applicati a esempi specifici con dati sintetici e possibilmente sperimentali.

#### 3. Activity Plan

The researcher will acquire or consolidate, preliminarily or in parallel with the research activity, advanced methods and techniques useful for the subject of investigation and be able to use suitable numerical and software tools. In particular, to reach the algorithmic and application research goals, the researcher will:

- perform a detailed study of the state of the art on advanced methods and software tools for optimization and control;

- develop numerical methods and software tools for the problems under investigation and test them in simulations;
- model application scenarios in the context of smart industrial and robotic systems for testing the proposed tools;
- attend national and international courses and conferences.