2018-00890 - PhD - Distributed Optimization

Contract type: Public service fixed-term contract
Level of qualifications required: Graduate degree or equivalent
Function: PhD Position

Context
Inria promotes “scientific excellence in the service of technology transfer and society.” Inria employs 2,700 people from the world’s leading universities to tackle the challenges of computer science and mathematics. Its open model allows it to explore original paths with its industrial and academic partners. Inria is at the origin of many innovations creating value and jobs. The position will be attached to the INRIA center in Paris (https://www.inria.fr/en/centre/paris/) and more specifically to the Inria - Microsoft Research Joint Centre and the DYOGÈNE research team.

Assignment
Real world machine learning problems involve increasingly bigger models that are trained on huge amounts of data, very often unable to fit into one machine, as powerful as it may be. Mobile devices now represent a non-negligible share of the total available computing power, even though each device has limited resources. In the past years, many distributed optimization algorithms such as decentralized gradient descent [N09] or decentralized dual averaging [DAW12] have emerged in order to address problems in which the data is inherently distributed, but they exhibited sublinear convergence rates. The very popular distributed alternating direction method of multipliers (D-ADMM) [BPC+11] has led to many variants and new methods with provably linear convergence rates have been developed [SLLY12, NOSS17]. Solutions to efficiently distribute stochastic gradient methods have also been investigated [SVS14, IBH17].

These algorithms tackle typical machine learning optimization problems where the function to optimize is the sum of the local functions at each node. However, the dependency of the convergence rates of these algorithms on the characteristics of the nodes (computing power) and of the communication network (topology, delays) still lacks a clear theoretical framework.

The goal of this PhD thesis is to build on previous work [SBR+17] to elaborate new distributed optimization algorithms that integrate hardware constraints in a principled way. The student will explore lower bounds on the complexity to solve such optimization problems in order to give provably optimal algorithms for realistic settings. In particular, heterogeneous computing power and communication time will be investigated in asynchronous settings, for example using stochastic gradients. There will also be a focus on decentralized algorithms in order to highlight settings for which they beat centralized solutions.

These lower bounds aim at giving practitioners a set of tools to guide them in their choice of optimization algorithm. Therefore, a part of this thesis will be devoted to experimentation on standard infrastructure (computing cluster or cloud service). These experiments should both guide and validate the way constraints are taken into account and demonstrate the practical interest of the proposed solutions.

Main activities
Research work, design of algorithms, proof of their performances, experimental validations, preparation of articles, participation in conferences, stays at MSR Redmond.

Benefits package
- Subsidised catering service
- Partially-reimbursed public transport

Remuneration
- Duration: 3 years
- Targeted hiring date: 01/10/2018
- Location: Paris
- Gross Salary per month: 1982€ (Year 1 and 2) then 2085€ (Year 3)

About Inria
Inria, the French National Institute for computer science and applied mathematics, promotes “scientific excellence for technology transfer and society.” Graduates from the world’s top universities, Inria’s 2,700 employees rise to the challenges of digital sciences. With its open, agile model, Inria is able to explore original approaches with its partners in industry and academia and provide an efficient response to the multidisciplinary and application challenges of the digital transformation. Inria is the source of many innovations that add value and create jobs.

Conditions for application
Defence Security:
This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating to the protection of national scientific and technical potential (PPST). Authorization to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PPST. An unfavourable Ministerial decision in respect of a position situated in a ZRR would result in the cancellation of the appointment.

Recruitment Policy:
Inria is at the origin of many innovations creating value and jobs. All Inria positions are accessible to people with disabilities.

Warning: you must enter your e-mail address in order to save your application to Inria. Applications must be submitted online on the Inria website. Processing of applications sent from other channels is not guaranteed.