2023-06134 - Post-Doctoral Research Visit F/M Federated Learning under Energy Limit

**General Information**

- **Theme/Domain**: Optimization, machine learning and statistical methods
- **Town/city**: Villeneuve d'Ascq
- **Inria Center**: Centre Inria de l'Université de Lille
- **Starting date**: 2023-10-01
- **Duration of contract**: 2 years
- **Deadline to apply**: 2023-09-30

**Contact**

- **Inria Team**: MAGNET
- **Recruiter**: Tommasi Marc / Marc.Tommasi@inria.fr

**About Inria**

Inria is the French national research institute dedicated to digital science and technology. It employs 2,600 people. Its 200 agile project teams, generally run jointly with academic partners, include more than 3,500 scientists and engineers working to meet the challenges of digital technology, often at the interface with other disciplines. The Institute also employs numerous talents in over forty different professions. 900 research support staff contribute to the preparation and development of scientific and entrepreneurial projects that have a worldwide impact.

**Assignment**

The context of this project is Federated Learning (FL) where devices have an a priori and known budget for energy consumption. The exact energy consumption of devices is unknown, but can be evaluated by local measurements reported by middleware toolkits, like PowerAPI (http://powerapi.org). The aim is to design and implement online strategies in FL algorithms that are adaptive to the constraints of the energy limit and to the consequences of these constraints. You will study the impact of budgeted limits and energy consumption approximation on the client and the server side. In particular, devices can adapt the amount of information sent to the server and reduce the computational cost of gradients (using, for instance, quantization or sampling data or parameters). On the server side, it is therefore necessary to mitigate the induced biases due to the unavailability of the devices, the heterogeneity of the collected gradients. These strategies are driven by local information in the first place, but need to be tuned in a collaborative way.

**Main activities**

The post-doctoral research activity includes several key steps:

- Study (local) energy consumption measurement. This include the quality and robustness of PowerAPI measurements, the impact of quantization, model sizes, batch sizes, loss function in classical gradient descent-descent algorithms. Model predictions for energy consumption could also be studied and evaluated;
- Study and manage the impact of heterogeneity of gradients at the server level on the convergence and the accuracy in (standard) aggregation steps. Possible strategies to mitigate the induce bias could also depend on auxiliary knowledge communicated by the clients;
- Devise new collaborative approaches for adaptive consumption of the budget across FL iterations.

**Skills**

PhD in computer science, machine learning, or software
engineering/distributed computing,
Strong programming skills in Python/Pytorch.
Prior experience in Federated Learning will be an asset.

Benefits package
- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

Remuneration
Gross monthly salary (before taxes): 2788€