Offer #2024-07838

PhD Position F/M Goal-Oriented Communications for Federated Learning

Contract type : Fixed-term contract

Level of qualifications required : Graduate degree or equivalent

Fonction : PhD Position

About the research centre or Inria department

The Inria research centre in Lyon is the 9th Inria research centre, formally created in January 2022. It brings together approximately 300 people in 17 research teams and research support services.

Its staff are distributed in Villeurbanne, Lyon Gerland, and Saint-Etienne.

The Lyon centre is active in the fields of software, distributed and high-performance computing, embedded systems, quantum computing and privacy in the digital world, but also in digital health and computational biology.

Context

This PhD position is supported by the Nokia-Inria Federated Learning Challenge, and will be hosted within the MARACAS team in the CITI Laboratory (a joint laboratory between Inria and INSA-Lyon). The position will be supervised by Dr Malcolm Egan and Prof. Jean-Marie Gorce (MARACAS) and Dr Alberto Conte and Marie-Line Alberia Morel (Networks Systems and Security Research, Nokia Bell Labs).

MARACAS is a research group consisting of approximately 15 people within Inria and INSA Lyon, this includes 6 PhD students, 2 postdocs, and 2 research engineers. The focus of MARACAS is in the theory, algorithms, and experimentation for communication systems, developing and applying methods in information theory, statistical signal processing and machine learning. The PhD position will complement existing projects on stochastic optimization and federated learning currently being carried out within MARACAS.

Assignment

The focus of the Inria-Nokia Federated Learning Challenge project is the development of federated and decentralized learning architectures and algorithms for future generation wireless communication systems. Federated learning systems support model estimation (e.g., training of deep neural networks) without providing the data stored in the clients directly to the server. Instead, the clients estimate local models and exchange the local model parameters or associated (sub)gradients with the server. This can dramatically reduce the amount of communication required and provide increased privacy. With the recent dramatic advances in the foundations of federated learning, the time is now ripe to investigate applications in emerging 6G wireless communication systems.

In the work carried out in this PhD position, we will ask two key questions:

(i) What is the impact of constraints imposed by realistic wireless communication links on state-of-the-art federated learning methods?

(ii) How can massive multiple access communications (e.g., coding, resource allocation, and signal processing) be optimized for state-of-the-art federated learning algorithms?

To address the first question, we will investigate the impact of wireless communications on the convergence of state-of-the-art federated learning algorithms. For the second question, new resource allocation, compression and coding schemes will be developed to optimize tradeoffs between reliability of communications (e.g., error-rates) and compression of federated learning updates.

Main activities

The candidate will carry out research on federated learning algorithms in collaboration with members of the MARACAS Inria and Networks Systems and Security Research (Nokia Bell Labs). This includes

participation in local seminars as well as in summer schools and international conferences. The candidate will also have the opportunity to do limited teaching within INSA Lyon.

Main activities:

- Analyze convergence of state-of-the-art federated learning methods in the presence of realistic limitations arising from emerging 6G wireless communication systems.
- Develop new coding, resource allocation, and compression schemes to mitigate the impact of errors arising from wireless communications.

Skills

Technical skills:

- Background in optimization theory, probability theory/statistics, and wireless communications;
- Ideally exposure to stochastic optimization algorithms and the corresponding convergence theory;
- proficiency in python and ideally experience with machine learning packages.

The candidate must have a high level of spoken and written English.

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 (90 days / year) 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
- Complementary health insurance under conditions

Remuneration

1st and 2nd year: 2 100 euros gross salary /month

3rd year: 2 190 euros gross salary / month

General Information

- **Theme/Domain :** Networks and Telecommunications
  System & Networks (BAP E)
- **Town/city :** Villeurbanne
- **Inria Center :** Centre Inria de Lyon
- **Starting date :** 2024-09-01
- **Duration of contract :** 3 years
- **Deadline to apply :** 2024-07-14

Contacts

- **Inria Team :** MARACAS
- **PhD Supervisor :**
  Egan Malcolm / malcom.egan@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.

> **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.

Instruction to apply

Applications must be submitted online on the Inria website.

Processing of applications sent by other channels is not guaranteed.

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).Authorisation 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 :
As part of its diversity policy, all Inria positions are accessible to people with disabilities.