Offer #2025-09162

Post-Doctoral Research Visit F/M Adaptive Communication for Personalized Federated Learning

Contract type : Fixed-term contract

Level of qualifications required : PhD or equivalent

Fonction : Post-Doctoral Research Visit

About the research centre or Inria department

The Inria centre at Université Côte d'Azur includes 42 research teams and 9 support services. The centre's staff (about 500 people) is made up of scientists of di?erent nationalities, engineers, technicians and administrative staff. The teams are mainly located on the university campuses of Sophia Antipolis and Nice as well as Montpellier, in close collaboration with research and higher education laboratories and establishments (Université Côte d'Azur, CNRS, INRAE, INSERM ...), but also with the regiona economic players.

With a presence in the fields of computational neuroscience and biology, data science and modeling, software engineering and certification, as well as collaborative robotics, the Inria Centre at Université Côte d'Azur is a major player in terms of scientific excellence through its results and collaborations at both European and international levels.

Context

Federated learning (FL) is a distributed machine learning approach that enables multiple clients to
collaboratively train a shared global model without exchanging their raw data, mitigating privacy
concerns and reducing communication costs. In standard FL, a single global model is learned by
aggregating locally trained updates from clients, assuming that all client data are drawn from a
similar distribution. However, in practice, client data are often highly heterogeneous—reflecting
diverse user behaviors and environments—which can lead to poor performance of the global model
on individual clients. Personalized federated learning (PFL) addresses this

challenge by adapting
the global training process to account for client-specific data characteristics.

The postdoc is funded by the Inria Challenge FedMalin on federated learning and will be based in the PREMEDICAL team.

Assignment

In this project, we will focus on two complementary thrusts: (1) designing metrics to quantify
statistical heterogeneity across client distributions; and (2) developing optimization and learning
algorithms that leverage these metrics to achieve provably effective personalized model training
under communication constraints.

Opportune Metrics for Statistical Heterogeneity

• Definition of Distributional Discrepancy Metrics: Develop novel measures that capture
both global and local differences in feature–label joint distributions, extending beyond
traditional divergence measures (e.g., Wasserstein, KL, MMD) to incorporate feature
relevance and task-specific losses.
• Weak-Communication Adaptation: Adapt metrics to settings with limited exchange of
summary statistics, ensuring that clients can compute and share compact heterogeneity
scores without revealing raw data.

2.2. Novel Learning Algorithms

• Personalized FL Algorithms with Optimal Client Selection: Design algorithms that use
heterogeneity-aware metrics to optimally select weighted subsets of clients for aggregation.
These methods aim to minimize gradient variance and reduce model bias by ensuring that
selected clients are both representative and informative. The approach will be grounded in
theoretical analysis and empirically validated in federated settings.
• Communication-Efficient Protocols: Integrate sampling schemes with quantization and
compression techniques to ensure compatibility with bandwidth constraints, analyzing trade-
offs between compression error and sampling-induced variance.

To evaluate the usefulness of the proposed techniques, we will work with synthetic data and open
benchmark datasets. The research will be made available in open access and we will seek to publish
the work in top machine learning venues.

Main activities

- Develop and analyze new algorithms
- Run experiments on benchmark data
- Publish papers in top-tier machine learning venues

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 (after 6 months of employment) 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
- Contribution to mutual insurance (subject to conditions)

Remuneration

Gross Salary: 2788 € per month.

General Information

- **Theme/Domain :** Optimization, machine learning and statistical methods
- **Town/city :** Sophia Antipolis
- **Inria Center :** Centre Inria d'Université Côte d'Azur
- **Starting date :** 2025-10-01
- **Duration of contract :** 12 months
- **Deadline to apply :** 2025-08-31

Contacts

- **Inria Team :** PREMEDICAL
- **Recruiter :**
  Bellet Aurelien / aurelien.bellet@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. Collecting applications 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.