Offer #2024-07688

PhD Position F/M Neural Linear Solvers and Preconditioners for General Sparse Matrices

**Contract type:** Fixed-term contract

**Level of qualifications required:** Graduate degree or equivalent

**Function:** PhD Position

**Context**

Numerical simulation is a strategic tool crucial for research in several scientific fields, from Computational Fluid Dynamics (CFD) for aeronautics design to Darcy flow in porous media for CO₂ storage and geothermal energy. The performance of numerical simulators is a critical factor directly impacting both result quality and the ability to perform large-scale computations. Adapting industrial codes to fully harness the capabilities of modern supercomputers (including computational accelerators such as GPUs) is a major challenge.

**Assignment**

In many numerical simulators, the resolution of ill-conditioned linear systems represents the most time-consuming step. The objective of this work is therefore to accelerate the convergence of preconditioned linear system resolution through Machine Learning. Two main approaches will be investigated especially for the coarse operator of two-level methods.

**Main activities**

In order to obtain convergence guarantees on the result, the candidate will also investigate hybrid algorithms where these trained models are directly plugged in classical iterative preconditioned linear system solvers such as PGMRES or PBiCGStab. The developed hybrid approaches will be assessed in terms of CPU/GPU cost and the number of matrix-vector products required to achieve convergence in representative test cases.

**Skills**

Master’s degree or equivalent with a strong background either in Machine Learning, Mathematics or Computer Science.

**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

**Remuneration**

According to profile

**General Information**

- **Theme/Domain:** Distributed and High Performance Computing Scientific computing (BAP E)
- **Town/city:** Paris
- **Inria Center:** Centre Inria de Paris
- **Starting date:** 2024-09-02
- **Duration of contract**: 3 years
- **Deadline to apply**: 2024-06-30

**Contacts**

- **Inria Team**: ALPINES
- **PhD Supervisor**: Nataf Frederic / Frederic.Nataf@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**

**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.