



Offer #2024-07077

Post-Doctoral Research Visit F/M Interpretability of persistent homology

Contract type : Fixed-term contract

Level of qualifications required : PhD or equivalent

Fonction : Post-Doctoral Research Visit

Context

The post-holder will be a member of the DataShape team, and work under the supervision of Nina Otter.

DataShape is a research team in Topological Data Analysis (TDA), constituted of researchers from Inria-Saclay, Inria Sophia Antipolis, and from the Laboratoire de Mathématiques d'Orsay. TDA is a recent field whose aim is to uncover, understand and exploit the topological and geometric structure underlying complex and possibly high-dimensional data. The DataShape team gathers a unique variety of expertise that allows it to embrace the mathematical, statistical, algorithmic and applied aspects of the field in a common framework ranging from fundamental theoretical studies to experimental research and software development.

Assignment

More information on the proposed research subject :

Persistent homology (PH) is one of the most successful methods in the field of topological data analysis (TDA). In recent years, PH has seen important theoretical advancements on the one hand, and hundreds of successful applications on the other. There is, however, a lack of understanding on why PH is successful in these applications, as it is still elusive what type of topological and geometric features are captured with the long and short persistence intervals, which provide information about the connected components, holes and cycles in higher dimensions. The main overall objective of this project is to make first steps in bridging this gap, by gaining an understanding on why and when PH works. In particular, we will develop methods to study regions of data that are most relevant for a particular PH-based classification or regression pipeline, and subsequently use this framework to gain a better understanding on both new as well as existing successful applications of PH. New applications that will be investigated will stem from the fields of operations research (i.e., optimisation of humanitarian-aid relief networks) and medical imaging (i.e., breast-cancer prediction).

Collaboration:

The post-holder will closely work with Nina Otter.

Responsibilities:

The person recruited is responsible for conducting research, preparing articles for peer-reviewed publications, disseminating research at local, national and international seminars and conferences.

Main activities

Main activities:

- Propose a framework to study relevance of regions in data for PH-based pipelines
- Develop Python code to test such framework on a variety of synthetic and real-world data sets
- Test, change up until validation
- Write documentation and reports
- Prepare manuscript for submission in peer-reviewed journals or conference proceedings
- Present the work's progress to other DataShape group members during the DataShape seminar

Additional activities:

- Participation in local, national and international seminars and conferences

Skills

Technical skills and level required: PhD in mathematics, computer science, or other relevant domain; strong background in Topological Data Analysis, and research experience in the field.

Languages: English.

Relational skills: Experience in working in scientific collaborations.

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
- Social security coverage

General Information

- **Theme/Domain :** Optimization, machine learning and statistical methods
Statistics (Big data) (BAP E)
- **Town/city :** Orsay
- **Inria Center :** [Centre Inria de Saclay](#)
- **Starting date :** 2024-06-01
- **Duration of contract :** 12 months
- **Deadline to apply :** 2024-05-31

Contacts

- **Inria Team :** [DATASHAPE](#)
- **Recruiter :**
Otter Nina Lisann / nina-lisann.otter@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.

The keys to success

Essential qualities in order to fulfil this assignment are a strong experience in working with applications in Topological Data Analysis, a genuine interest for investigating the interpretability of persistent homology, proficiency in Python, and working knowledge with several state-of-the-art neural network architectures.

Cross-disciplinary knowledge and expertise in the area of operations research is a real asset for this position.

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.