Offer #2023-07027

Internship Position F/M Unveiling The Links between Cognition and Neuroimaging through Contrastive Learning Regression

Contract type: Fixed-term contract
Renewable contract: Yes
Level of qualifications required: Graduate degree or equivalent
Fonction: Internship Research

About the research centre or Inria department

The Inria Saclay-Île-de-France Research Centre was established in 2008. It has developed as part of the Saclay site in partnership with Paris-Saclay University and the Institut Polytechnique de Paris since 2021.

The centre has 39 project teams, 27 of which operate jointly with Paris-Saclay University and the Institut Polytechnique de Paris. Its activities occupy over 600 scientists and research and innovation support staff, including 54 different nationalities.

Context

Within the framework of a partnership
- collaboration MIND Inria team, the Lariboisiere Hospital, and the Paris Descartes University

The recruited candidate is expected to develop a mathematical model and a software prototype for the application of contrastive learning to linking cognition and neuroimaging data.

Specifically

Introduction

The link between the human brain function, anatomy, and cognition remains uncharted territory. Brain imaging techniques, such as functional magnetic resonance imaging (fMRI) and diffusion magnetic resonance imaging (dMRI), provide in vivo information about neural activity and structural connectivity. However, linking these imaging modalities to cognitive functions poses a significant challenge. Specifically, current efforts for linking multivariate cognition measurements with neuroimaging are based on Partial Least Squares and Canonical Correlation Analysis techniques with poor out-of-sample generalization.

Deep Learning and Contrastive Learning

Within the deep learning field, contrastive learning, an emerging deep learning paradigm, has demonstrated remarkable success in unsupervised representation learning, particularly in the realm of natural language processing and computer vision.

Contrastive Learning Regression: An Open Field

While contrastive learning has garnered significant attention for its impressive performance in classification tasks, its application to regression problems remains unsolved. This presents an opportunity to expand the capabilities of contrastive learning and harness its potential in domains that demand continuous prediction, such as neuroimaging analysis.

Linking Brain Imaging and Cognition with Contrastive Learning Regression

The project will explore developing and applying contrastive learning regression frameworks to link fMRI and dMRI data with cognitive measures.

Assignment
Assignments:
With the help of D. Wassermann the recruited person will be taken to produce a deep-learning based system for the prediction of cognitive abilities from neuroimaging data.

The primary assignments for this project are:

1. To evaluate current and develop novel contrastive learning regression frameworks for linking brain imaging data to cognitive measures and characterize their limitations.
2. To evaluate the performance of these frameworks on benchmark datasets, comparing their effectiveness to traditional regression approaches.
3. To investigate the interpretability of the learned representations and identify brain regions and structural connections associated with specific cognitive functions.

Main activities

Main activities (5 maximum):

- Analyse the requirements of the neuroimaging and neurosurgical applications
- Develop pipelines for the application of contrastive learning-based models to the neuroimaging and neurosurgical cases
- Design an experimental platform for the implementation of the above pipelines
- Validate the advancements and write scientific literature on them

Skills

Technical skills and level required:

- Good master of python programming
- Comfortable with math formalisms and the formal background of machine learning and AI
- Skills in development deep learning models are desirable

Languages:

- The candidate is expected to be able to communicate proficiently in 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 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

According to profil

General Information

- Theme/Domain: Computational Neuroscience and Medicine Biologie et santé, Sciences de la vie et de la terre (BAP A)
- Town/city: Palaiseau
- Inria Center: Centre Inria de Saclay
- Starting date: 2022-03-01
- Duration of contract: 2 years, 4 months
- Deadline to apply: 2024-02-29

Contacts

- Inria Team: MIND
- Recruiter: Wassermann Demian / demian.wassermann@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**

The successful candidates will have:

- a taste for collaborative work
- good communication skills
- an independent self-driven personality
- an appetite for cross-disciplinary work

**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.