



Offer #2021-03535

PhD Position F/M Deep learning for assisting diagnosis of neurological diseases using a very large-scale clinical data warehouse

Level of qualifications required : Graduate degree or equivalent

Fonction : PhD Position

Context

You will work within the ARAMIS lab (www.aramislab.fr) at Inria and at the Paris Brain Institute (<https://institutducerveau-icm.org>). The institute is ideally located at the heart of the Pitié-Salpêtrière hospital, downtown Paris.

The ARAMIS lab is dedicated to the development of new computational approaches for the analysis of large neuroimaging and clinical data sets. With about 35 people, the lab has a multidisciplinary composition, bringing together researchers in machine learning and statistics and medical doctors (neurologists, neuroradiologists).

The thesis will be directed by Olivier Colliot (Research Director, HDR) and co-supervised by Ninon Burgos (Research Scientist).

Assignment

Neurological diseases are a major public health concern. Early and accurate diagnosis is essential to provide adequate care for the patients and design effective clinical trials to find new treatments. Neuroimaging plays a major role in the diagnosis of these disorders. Artificial intelligence techniques offer important promises to assist diagnosis (Burgos et al, 2021). Successful results have been obtained for the automatic classification of some disorders (e.g. Wen et al, 2020). However, these computer-assisted diagnosis systems remain very narrow in the sense that they are restricted to one or a few diseases.

In recent years, very large hospital data warehouses have been constituted. In particular, the data warehouse of the AP-HP (Assistance Publique-Hôpitaux de Paris) gathers data from all the hospitals of the greater Paris area, including clinical data, diagnoses, medical reports and medical imaging data (MRI, PET, CT). For instance, it gathers over 130,000 MRIs from adult patients with various types of disorders. This resource constitutes a fantastic opportunity to train efficient deep learning models. Very recently, our team was the first to publish a deep learning tool for neuroimaging data built using the AP-HP data warehouse (Bottani et al, 2021). This tool allows performing automatic quality control of T1- weighted MRI data and thus selecting the data which are usable for training deep learning models.

The aim of this project is to design and validate deep learning methods for computer-assisted diagnosis of neurological disorders using a very large dataset (over 100,000 patients) from the AP-HP data warehouse.

The first objective will be to design an approach for differential diagnosis from T1-weighted MRI data. A major challenge will be to be able to deal with a very large set of possible diagnoses (several hundreds), some of which may be co-existing in the same patient. This will require the design of dedicated deep learning architectures that account for these specificities.

A second objective will be to extend the work to other types of brain imaging data (other MRI sequences such as T2-weighted, FLAIR, diffusion MRI; CT; PET). To that purpose, we will first aim to extend the automatic quality control approach that we proposed for T1-weighted MRI to other modalities. Then, we will design a computer-aided diagnosis method that can use multimodal data as input.

Finally, if time permits, we propose to explore the design of models that could automatically generate medical reports from imaging data. This is a challenging task, that has so far only been proposed for much simpler data such as 2D X-ray radiographs. To that purpose, we will propose new architectures that are adapted to the encoding of images for subsequent text generation.

References

- Burgos N, Bottani S, Faouzi J, Thibeau-Sutre E, and Colliot O. Deep learning for brain disorders: from data processing to disease treatment. Briefings in Bioinformatics. 2021; 22(2):1560–1576 <https://hal.archives-ouvertes.fr/hal-03070554>
- Wen J, Thibeau-Sutre E, Diaz-Melo M, Samper-González J, Routier A, Bottani S, Dormont D, Durrleman S, Burgos N, and Colliot O. Convolutional neural networks for classification of

Alzheimer's disease: Overview and reproducible evaluation. Medical Image Analysis. 2020; 63:101694. <https://hal.archives-ouvertes.fr/hal-02562504>

- Bottani S, Burgos N, Maire A, Wild A, Ströer S, Dormont D and Colliot O, for the APPRIMAGE study group, Convolutional neural networks for the automatic quality control of brain T1-weighted MRI from a clinical data warehouse. 2021 <https://hal.inria.fr/hal-03154792>

Main activities

- Develop research in the field of deep learning for brain imaging
- Write scientific articles for publication in international journals and conference proceedings
- Present results at international conferences
- Contribute to the implementation and dissemination of open source software

Skills

- Master or engineering degree with a specialization in machine learning
- Strong interest for medical applications
- Good programming skills in Python
- Knowledge in digital image processing and medical imaging
- Good writing skills
- Good relational and communication skills

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

Remuneration

Monthly gross salary : 1982 € during the first and second years. 2085 € the last year.

General Information

- **Theme/Domain** : Computational Neuroscience and Medicine
- **Town/city** : Paris
- **Inria Center** : [Centre Inria de Paris](#)
- **Starting date** : 2021-10-01
- **Duration of contract** : 3 years
- **Deadline to apply** : 2021-06-30

Contacts

- **Inria Team** : [ARAMIS](#)
- **PhD Supervisor** :
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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.