Internship Research on Partial latent encoding of multi-spectral data (GEO-ReSeT 2/3)

Contract type: Internship agreement
Level of qualifications required: Graduate degree or equivalent
Fonction: Internship Research
Level of experience: Recently graduated

About the research centre or Inria department
The Inria centre at Université Côte d'Azur includes 37 research teams and 8 support services. The centre's staff (about 500 people) is made up of scientists of different 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
The work will be embedded in a project in collaboration between Université de Paris Cité (team LIPADE, Paris) and Inria (team EVERGREEN, Montpellier).

By using location on the Earth's surface as the common link between different modalities, a geo-spatial foundation model would be able to incorporate a variety of data sources, including remote sensing imagery, textual descriptions of places, and features in maps. Leveraging the large amounts of available unlabeled geo-spatial data from these different sources, the GEO-ReSeT (Generalized Earth Observation with Remote Sensing and Text) ANR project has the objective to learn a better representation of any geo-spatial location and convey a semantic representation of the information.

Such a foundation model has the potential to revolutionize Earth observation by allowing for few or zero-shot solutions to classical problems such as land-cover and land-use mapping, target detection, and visual question answering. It will also be useful for a wide range of applications with a geo-spatial component, including environmental monitoring, urban planning and agriculture.

By leveraging several data modalities, this foundation model could provide a more comprehensive and accurate understanding of the Earth's surface, enabling more informed decisions and actions. This will be particularly valuable for new potential users in sectors such as journalism, social sciences or environmental monitoring, who may not have the resources or expertise to collect their own training datasets and develop their own methods, thus moving beyond open Earth observation data and democratizing the access to Earth observation information.

Assignment
The work to be conducted during the proposed M2 internship will contribute to the ambition of the GEO-ReSeT ANR project by proposing a new methodology for projecting multi-modal data of different natures to a common latent space. One classical way to achieve this is through a contrastive self-supervised learning approach. A feature extractor for each modality is trained through a contrastive loss. This loss ensures that similar examples (in the case of geo-spatial data, from the same geographical location) are close in the feature space, while dissimilar examples are projected far away. These self-supervised models can then be used on downstream tasks through linear probing.
This approach tends to work well on natural images and has been successfully on geo-spatial data, such as remote sensing image. However, retaining the particularities of each modality, each given partial information of the underlying reality, is a challenge. In this work, the authors propose to learn factorized representations of each modalities.

**Main activities**

In this work, our objective is to explicitly model which part of the latent space is concerned with each of the modalities. We propose to achieve this objective by modeling the uncertainty on the feature representation of each modality. The work to be performed in this internship will lead to the following three contributions:

- **Contribution A:** the candidate will propose a methodology for self-supervised learning of a joint embedding of multi-modal data. This methodology will explicitly encode the uncertainty during the learning process and at inference.
- **Contribution B:** the candidate will choose and implement a baseline that can be used for comparison with the proposed method.
- **Contribution C:** the candidate will choose a downstream task on which the proposed methodology can be evaluated. A detailed evaluation will be conducted.

**Skills**

- Python programming
- Deep Learning with Python (preferably with Pytorch)
- Experience with Remote Sensing imagery

**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:** Data and Knowledge Representation and Processing Statistics (Big data) (BAP E)
- **Town/city:** Montpellier ou Paris
- **Inria Center:** Centre Inria d’Université Côte d’Azur
- **Starting date:** 2024-01-01
- **Duration of contract:** 6 months
- **Deadline to apply:** 2024-01-31

**Contacts**

- **Inria Team:** ZENITH
- **Recruiter:** Marcos Gonzalez Diego / diego.marcos@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**

We are looking for someone with strong competences in Python programming and Deep Learning, ideally with experience with geospatial data.

**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.