Laboratoire d'Informatique
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Équipe Reconnaissance des
Formes et Analyse d'Images
www.rfai.li.univ-tours.fr

PhD position

Continual/life long learning for time series prediction in environmental sciences

Profile: Master or Engineering degree or equivalent in computer sciences (Machine learning, data sciences) or applied mathematics
Duration: 3 years, starting from September 15th 2023
Affiliation: Computer Science Lab of Université de Tours (LIFAT), Pattern Recognition and Image Analysis Group (RFAI)
Grant: around 1600€-1700€/month
Supervisors: Nicolas RAGOT MCF HDR, Thierry Brouard MCF (LIFAT-Tours)
Skills:
- a good experience in data analysis and machine learning (theory and practice of deep learning in python) is required
- experiences/knowledge in time series prediction and environmental science is welcome
- curiosity and ability to communicate (in English at least) and work in collaboration with scientists from other fields
- autonomy and good organization skills

How to candidate:
Send the following documents by e-mail to **nicolas.ragot [at] univ-tours.fr** before 20th of June: a CV, a motivation letter, a short description of your experiences in machine/deep learning, references from academics.

Context:
The JUNON project, driven by the BRGM, is granted from the Centre-Val de Loire region through ARD program (« Ambition Recherche Développement ») which goal is to develop a research & innovation pole around environmental resources (agriculture, forest, waters…). The main goal of JUNON is to elaborate digital services through large scale digital twins in order to improve the monitoring, understanding and prediction of environmental resources evolution and phenomena, for a better management of natural resources. Digital twins will allow to virtually reproduce natural processes and phenomena using combination of AI and environmental tools.
JUNON will focus on the elaboration of digital twins concerning quality and quantity of ground waters, as well as emissions of greenhouse gases and pollutants with health effects, at the scale of geographical area corresponding to the North part of the Centre-Val-de-Loire region.

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These digital twins will rely on geological and meteorological knowledge and data (time series), as well as physic-based models.
The project actors are: BRGM, Université d'Orléans, Université de Tours, CNRS, INRAE, and ATOS and ANTEA companies. There are 5 work packages (WP):

1. User's needs and geological knowledge for ground water
2. User's needs and biological/chemical knowledge about pollutants and greenhouse gases
3. Data management and data mining
4. Time series prediction
5. Aggregation and realization of digital twins themselves

The PhD position will be in the WP4, focused on the prediction of quantity of ground waters and/or prediction of ground/air pollutants. There will be strong interactions inside WP4 with other potsdocs and PhD, with WP1 and 3 (BRGM) through postdocs and engineers. The work will be supervised by the LIFAT - RFAI. Interaction with the RFAI group and other PhDs working on similar subjects will also be done.

Goals:
Postdocs at the BRGM and LIFAT will have in charge respectively to collect and arrange data (ground waters levels at different locations) and to benchmark predictions with mechanistic models as well as with classical prediction AI tools integrating several sources of information like:
- meteorological data
- spatial information, i.e. geolocalization of sensors and locations of predictions to be made; topological information such as altitude
- integration of knowledge from mechanistic models as well as from expert knowledge (impact of attributes and variables used)
- etc.

The goal of the PhD will be, relying on these data and protocols, to work on new learning algorithms to allow these AI models to learn continuously giving new observed data as a stream. The scientific locks are clearly related to continual learning for Deep Learning prediction models and especially to deal with:
- few shot learning in DL
- drift and anomaly detection,
- plasticity/stability dilemma
- adapting such algorithms to suggested models by postdoc, based on Transformers or Spatio-Temporal Graph Neural networks using heterogeneous data.

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Hosting group:
The RFAI group (Pattern Recognition and Image Analysis) is part of the LIFAT (EA 6300) computer science lab. The group is composed of 5 Professors, 3 HDR (associate professors habilitated), 10 associate professors, 9 PhDs plus 4 co-supervised PhDs in other universities. The group is working mainly on pattern recognition and machine learning for image/video analysis and temporal data with application domains mainly in health, environment and humanities. The group has access to several computing resources and especially to Leto computer (CPU nodes + 4 gpu nodes with 4 Nvidia Tesla v100 each).

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- Sijie Yan and Yuanjun Xiong and Dahua Lin, *Spatial Temporal Graph Convolutional Networks for Skeleton-Based Action Recognition*, AAAI'18, arXiv:1801.07455, paper with code, 2018

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