Offer #2025-08742

Post-Doctoral Research Visit F/M Deep algorithmic models for causal discovery from individual observations

Contract type : Fixed-term contract

Level of qualifications required : PhD or equivalent

Fonction : Post-Doctoral Research Visit

About the research centre or Inria department

The Centre Inria de l'Université de Grenoble groups together almost 600 people in 23 research teams and 9 research support departments.

Staff is present on three campuses in Grenoble, in close collaboration with other research and higher education institutions (Université Grenoble Alpes, CNRS, CEA, INRAE, …), but also with key economic players in the area.

The Centre Inria de l'Université Grenoble Alpes is active in the fields of high-performance computing, verification and embedded systems, modeling of the environment at multiple levels, and data science and artificial intelligence. The center is a top-level scientific institute with an extensive network of international collaborations in Europe and the rest of the world.

Context

The work will take place in the Grenoble Computer Science Laboratory, located in Saint Martin d'Hères, France.

Assignment

Context
Networks such as modern telecommunications networks or distributed embedded systems are permanently monitored to allow identification of failure situations; thousands of new data points reflecting the system state changes are generated every minute. Even if faults are rare events, they can easily propagate driven by local and remote dependencies, which makes it challenging to distinguish causes from effects among the thousands of highly correlated alerts. It is nevertheless crucial to infer causal relations in the form of a causal graph if one wants to timely automate the identification and analyze the root cause of the performance problems. The discovery of causal graphs in such networks is however made difficult by the fact that the data collected, typically in the form of vectors or strings representing event logs, represent single data points; thus, in the absence of prior knowledge, about, e.g., distributions of events, well-known statistical inference approaches are not applicable.

Goal and approach
The objective of this project is to develop new methods, potentially combining approaches from deep learning and algorithmic decision theory, to infer a causal graph that represents the dependencies between components (or nodes) of the network, given a set of event logs and possibly sampled KPIs of these components. Deep neural networks, and in particular Large Language Models (LLMs), have recently been used for causal discovery and causal reasoning tasks [1][2]. If their capacity regarding causality is limited, they nevertheless provide a general framework that can be leveraged for discovering causal graphs. Along this line, we are currently studying a neural network aiming to mimic the ranking provided by the conditional Kolmogorov complexity for sequences of characters, from which one could infer causal relations following [3].
Learning such a network however requires training data which may not be well aligned with the single observation, event logs we want to analyze. One simple (and naïve) approach to solve this problem consists in leveraging the predictive power of LLMs, in, e.g., a zero-shot setting, using the context to assess conditional probabilities and complexities. It is however very likely that this approach will fail to
identify many causal relations and more complex approaches, including fine-tuning and the use of additional neural networks and/or algorithmic decision tools, will have to be explored in the framework of this post-doc.
The selected candidate will benefit from a large degree of autonomy for conducting her/his research and will collaborate with researchers from Nokia Bell Labs and Inria/MIAI Cluster.

Main activities

cf. above

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 (90 days / year) and flexible organization of working hours
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage under conditions

Remuneration

2788 € gross salary / month

General Information

- **Theme/Domain :** Embedded and Real-time Systems
  Statistics (Big data) (BAP E)
- **Town/city :** Saint Martin d'Hères
- **Inria Center :** Centre Inria de l'Université Grenoble Alpes
- **Starting date :** 2025-12-01
- **Duration of contract :** 12 months
- **Deadline to apply :** 2025-04-17

Contacts

- **Inria Team :** SPADES
- **Recruiter :**
  Goessler Gregor / gregor.goessler@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

Candidates should be pursuing internationally recognized research in ML/AI, or Information Theory with a strong interest in causal inference and causal reasoning.

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.