Offer #2025-08829

Post-Doctoral Research Visit F/M Postdoctoral Offer: Metacognition in Bio-Realistic Artificial Intelligence Networks

Contract type : Fixed-term contract

Level of qualifications required : PhD or equivalent

Fonction : Post-Doctoral Research Visit

Level of experience : Recently graduated

About the research centre or Inria department

The Inria center at the University of Bordeaux is one of the nine Inria centers in France and has about twenty research teams.. The Inria centre is a major and recognized player in the field of digital sciences. It is at the heart of a rich R&D and innovation ecosystem: highly innovative SMEs, large industrial groups, competitiveness clusters, research and higher education players, laboratories of excellence, technological research institute...

Context

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Every year Inria International Relations Department has a few postdoctoral positions **in order to support Inria international collaborations**.

The postdoctoral contract will have a duration of **24 months**. The default start date is **November 1st, 2025 and not later than January, 1st 2026**. The postdoctoral fellow will be recruited by one of the Inria Centres in France but it is recommended that the time is shared between France and the partner's country (please note that the postdoctoral fellow has to start his/her contract being in France and that the visits have to respect Inria rules for missions).

Assignment

Candidates for postdoctoral positions are recruited **after the end of their Ph.D. or after a first post-doctoral period:** for the candidates who obtained their PhD in the **Northern hemisphere, the date of the Ph.D. defense shall be later than September 1, 2022; in the Southern hemisphere, later than April 1, 2022.**

In order to encourage mobility, the postdoctoral position must take place in a scientific environment that is truly different from the one of the Ph.D. (and, if applicable, from the position held since the Ph.D.); particular attention is thus paid to French or international candidates who obtained their doctorate abroad.

Main activities

Metacognition is the cognitive process by which, instead of just learning to associate a response or a behavior with a situation, animals (and mainly primates) monitor the functioning (and particularly errors) of simple cognitive processes, learn to inhibit automatic responses and promote instead contextually appropriate behavioral rules.

Better understanding and modeling this process is important for several reasons. In cognitive neuroscience, it paves the way to exploring higher cognitive functions like reasoning, imagination and other kinds of deliberation-based thoughts. In Artificial Intelligence, it stands on the same grounds as Generative AI and proposes different processes and algorithms that might remedy several weaknesses of GenAI and suggest innovative brain-inspired extensions.

The Mnemosyne Inria team in Bordeaux and the Machine Learning CWI group in Amsterdam have a long experience in cognitive computational neuroscience and have recently launched a new project, MetaBrain, with the aim of specifying the computational mechanisms of metacognition, defining relevant tasks to assess the performance of metacognitive models and organizing a network of international teams contributing to the topic.

The role of the postdoctoral fellow to be recruited is to participate to the MetaBrain project, under the following axes:

Axis 1: Specification of Metacognition and its main computational mechanisms:

When several elementary competences have been learned (possibility to associate a response with a situation), the role of Metacognition (or cognitive control) is to control the performances of the competences, the selection or the coordination of the most appropriate ones depending on the context, or the creation of a new one. This is generally described through three main mechanisms: (i) the possibility to monitor cues indicating difficulties in the process of problem solving (errors or conflicts between resources), in order to inhibit elementary default responses, (ii) working memory to keep in sustained activity the different aspects to be integrated (goals and subgoals, predictions, constraints) and (iii) cognitive flexibility corresponding to new goals and contextual rules that can be learned and integrated in the process of problem solving.

Our two teams have already proposed models that address several aspects of these mechanisms (Dagar et al., 2021; Kruijne et al., 2020; Nallapu et al., 2019; Van den Berg, 2023) and are also aware of several other models in the literature proposing other candidate mechanisms (see for example Alexander and Brown, 2015; Botvinick et al., 2001, Collins et al., 2012; Domenech et al., 2015; Miller et al, 2024). All these models indicate possible correspondence with cerebral circuitries and adaptive operations. Nevertheless, they are many and split these general mechanisms in different pieces which are not always consistent and may differ under several aspects. A major contribution will be to carry out a thorough analysis of these elements, to propose a synthesis associating both a precise description of the mechanisms and a map of their functional dependencies.

Axis 2: Definition of relevant tasks in the domain of visual reasoning:

Although many standard tasks have been defined and shared for simple sensorimotor control, it is not yet the case for cognitive control, generally corresponding to much more complex behaviors. A variety of tasks have been proposed in models mentioned above but they differently integrate fundamental constituents such as hierarchical and temporal dependencies. In a similar view of standardization as in the axis above, the goal will be consequently to enumerate properties that have to be assessed when developing such metacognitive models and propose or design corresponding tasks.

Subsequently, the postdoctoral fellow will work on integrating the insights from Axis 1 and task definitions in this Axis, with an architecture that integrates selected mechanisms from the different frameworks, particularly under the perspective of extending and evaluating models proposed in our teams with novel properties.

Axis 3: Organization of an international network of collaboration on the topic:

We have already begun to identify and contact international (mainly European) teams working on the topic and willing to contribute to the elaboration of such a roadmap, toward more ambitious international projects. A corresponding goal will be to interact with these partners and to help with the preparation of such projects.

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 partial 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

Gross monthly remuneration (before salary charges and taxes): 2927 euros

General Information

- **Theme/Domain :** Computational Neuroscience and Medicine
  Information system (BAP E)
- **Town/city :** Bordeaux
- **Inria Center :** Centre Inria de l'université de Bordeaux
- **Starting date :** 2025-11-01
- **Duration of contract :** 2 years
- **Deadline to apply :** 2025-06-01

Contacts

- **Inria Team :** MNEMOSYNE (DIR-BOR)
- **Recruiter :**
  Alexandre Frederic / frederic.alexandre@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

This postdoc position is proposed for 24 months, starting on November 1st, 2025 and will be mainly located in the Mnemosyne team, in Bordeaux, France, with visits to the CWI partner in Amsterdam. More specifically, in addition to regular visio-meetings, a three-weeks stay in Amsterdam each year will be organized.

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 for this Inria-DRI postdoctoral position are submitted online and must include:
- A detailed CV with a description of the PhD and a complete list of publications with the two most significant ones highlighted.
- A motivation letter with a description of the candidate interests and planned methodology to tackle the research project.
- Two letters of recommendations

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.