Offer #2020-02980

Post-Doctoral Research Visit F/M Personalized Intelligent Tutorial Systems (ITS) for attention training: Modelling of personalization algorithms and effectiveness study

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 Inria Bordeaux Sud-Ouest centre is one of Inria's eight centres and has around 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

The **Flowers project-team**, at Inria and Ensta ParisTech, studies mechanisms that can allow robots and humans to acquire autonomously and cumulatively repertoires of novel skills over extended periods of time.
This includes mechanisms for learning by self-exploration, as well as learning through interaction with peers, for the acquisition of both sensorimotor and social skills. Sensorimotor skills include locomotion, affordance learning, active manipulation. Interactive skills include grounded language use and understanding, adaptive interaction protocols, and human-robot collaboration

The postdoctoral position addresses the challenge to build a "human-centered digital word" with innovative interactive systems providing "adaptive and personalized interactions with humans" for supporting "their wellbeing and health". Additionally, this PhD program is primarily based on interdisciplinary approach of individuals' intrinsic motivation (curiosity) as critical ingredient for synergistic human-computer interactions. Today, very few studies provide information on the impact of intrinsic motivation and curiosity on the inter-individual variability of learning across life span or on their neuro-protective role against the aging effects or attentional disorders.

The project will be performed in Flowers team in collaboration with C. Moulin-Frier, PY Oudeyer and D. Roy in order to achieve optimal leverage on the succeed KIDLEARN and KIDBREATH projects by generalizing them to another population, i.e. the elderly and young adults with attentional deficits. It also relies on active international collaborations, in particular with the laboratory of D. Bavelier at the University of Geneva (https://www.unige.ch/fapse/brainlearning /), an expert in neurosciences recognized worldwide for her work on the attentional training impacts of certain types of video games that we will use in this project.

Assignment

Flowers is an interdisciplinary research group, studying mechanisms that can allow robots and humans to acquire autonomously and cumulatively repertoires of novel skills over extended periods of time. The originality of the team's work is to focus on intrinsic motivation as an essential ingredient of learning, notably for tackling education challenges.

One of main team's purpose is studying how machine learning can be designed to guide each individual in his/her learning. To this end, the Flowers team develops an innovative mixed approach of Intelligent Tutorial Systems (ITS) that combines computational models of artificial curiosity and intrinsic motivation [1], Multi-Arm Bandit (MAB) techniques to efficiently manage the optimization process of curriculum exploration [2], and expert knowledge to constrain and bootstrap initial exploration of the MAB. The expected benefit is to provide ITS maximizing both learning progress and pedagogical efficiency (learner's motivation and engagement, time-gains for learning, etc). A such approach might be also relevant for reeducation issues where inter-individual variability, and thus intervention personalization are challenges of the same magnitude as those for education of children.
Consequently, the present postdoctoral program is part of this line of research and aims to transfer our mixed approach to the rehabilitation field of attention in young adults with cognitive disorders and in

older adults.

Main activities

Because of its cross-cutting nature to all cognitive activity such as learning tasks, attention is a hallmark of good cognitive health throughout life and more particularly in the current context of societal crisis of attention.
Recent works have shown the great potential of computerized attention training [3] for an example of attention training], with efficient training transfers to other cognitive activities, and this, over a wide spectrum of individuals (children, elderly, individuals with cognitive pathology such as Attention Deficit and Hyperactivity Disorders).
Despite this promising result, a major hurdle is challenging: the high inter-individual variability in responding to such interventions. Some individuals are good responders (significant improvement) to the intervention, others respond variably, and finally some respond poorly, not at all, or occasionally [4].
A central limitation of computerized attention training systems is that the training sequences operate in a linear, non-personalized manner: difficulty increases in the same way and along the same dimensions for all subjects [5]. However, different subjects require in principle a progression at a different, personalized pace according to the different dimensions that characterize attentional training exercises.
To tackle the issue of inter-individual variability, the present PhD project proposes to apply some principles from intelligent tutorial systems (ITS) to the field of attention training.

In this context, the Flowers team has developed automatic learning algorithms such as those developed in the KidLearn project, which allow to customize the learner's path according to his/her progress and thus optimize his/her learning trajectory while stimulating his/her motivation by the progress made [2, 6]. ITS are widely identified in intervention research as a successful way to address the challenge of personalization, but no studies to date have actually been conducted for attention training. Thus, whether ITS, and in particular personalization algorithms, can optimize the number of responders to an attention training program remains an open question. Additionally, as well documented in lifespan studies, motivational objects change across ages (for example, the interest for social stimuli increases with increasing age).

Consequently, the postodoral activities will be to assess thanks to experimental studies whether personalization according to the learning progress of the individual generates more responders and whether curiosity states induced by social contents of stimuli are a critical ingredient for the older adults to be responsive to the personalized
training.

References
1. Oudeyer, P. Y., & Smith, L. B. (2016). How evolution may work through curiosity□driven developmental process. *Topics in Cognitive Science*, 8(2), 492-502.
2. Clement, B., Roy, D., Oudeyer, P.-Y., & Lopes, M. (2015). Multi-Armed Bandits for Intelligent Tutoring Systems. *Journal of Educational Data Mining* (JEDM), 7(2), 20□
3. Cicerone, K. D., Goldin, Y., Ganci, K., Rosenbaum, A., Wethe, J. V., Langenbahn, D. M., ... & Trexler, L. (2019). Evidence-Based Cognitive Rehabilitation: Systematic Review of the Literature From 2009 Through 2014. *Archives of physical medicine and rehabilitation*.
4. Lampit A, Hallock H, Valenzuela M (2014) Computerized Cognitive Training in Cognitively Healthy Older Adults: A Systematic Review and Meta-Analysis of Effect Modifiers. *PLOS Medicine* 11(11): e1001756. https://doi.org/10.1371/journal.pmed.1001756
5. Belchior, P., Yam, A., Thomas, K. R., Bavelier, D., Ball, K. K., Mann, W. C., & Marsiske, M. (2019). Computer and Videogame Interventions for Older Adults' Cognitive and Everyday Functioning. *Games for health journal*, 8(2), 129-143.
6. Delmas, A., Clément, B., Oudeyer, P. Y., & Sauzeon, H. (2018). Fostering health education with a serious game in children with asthma: pilot studies for assessing learning efficacy and automatized learning personalization. In *Frontiers in Education* (Vol. 3, p. 99). Frontiers.

Skills

Required Knowledge and background: .

- Cognitive modelling and applied machine learning
- Strong skills in human-computer interaction and human factors
- Advanced knowledge for statistics applied to human performance
- Strong Interests for experimental studies with human

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

Remuneration

the gross monthly salary is set at 2653 euros (amount before payroll and income taxes)

General Information

- **Theme/Domain :** Robotics and Smart environments
- **Town/city :** Talence
- **Inria Center :** Centre Inria de l'université de Bordeaux
- **Starting date :** 2020-10-01
- **Duration of contract :** 2 years
- **Deadline to apply :** 2020-10-31

Contacts

- **Inria Team :** FLOWERS
- **Recruiter :**
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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.

The keys to success

Expected PhD domain : cognitive science and its related areas (psychology, cognitive neursocience, machine learning, etc.)

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

Please apply on the Inria website (jobs.inria) by submitting the following documents:
- CV including the list of publications
- cover letter
- possibly: letter(s) of recommendation

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.