2021-03485 - Post-Doctoral Research Visit F/M High Performance Reinforcement Learning

**Type de contrat :** CDI  
**Niveau de diplôme exigé :** Thèse ou équivalent  
**Fonction :** Post-Doctorant

**A propos du centre ou de la direction fonctionnelle**
Grenoble Rhône-Alpes Research Center groups together a few less than 650 people in 37 research teams and 8 research support departments.

Staff is localized on 5 campuses in Grenoble and Lyon, in close collaboration with labs, research and higher education institutions in Grenoble and Lyon, but also with the economic players in these areas.

Present in the fields of software, high-performance computing, Internet of things, image and data, but also simulation in oceanography and biology, it participates at the best level of international scientific achievements and collaborations in both Europe and the rest of the world.

**Contexte et atouts du poste**

- **Location:** Grenoble or Lille  
- **Hosting Teams:**  
  - SCOLL (INRIA Lille): [https://team.inria.fr/scoll/](https://team.inria.fr/scoll/)  
  - DataMove (INRIA Grenoble): [https://team.inria.fr/datamove](https://team.inria.fr/datamove)  
- **Contact:** Bruno.Raffin@inria.fr and Philippe.Pueux@inria.fr  
- **Period:** to start somewhere by April 2021  
- **Duration:** 24 months  
- **Requirement:** PhD in computer Science

**Mission confiée**

Reinforcement learning goal is to self-learn a task trying to maximise a reward (a game score for instance). The learning process acts by interacting with a simulation code to explore the space of possible states. As an explicit exploration is not possible too large, the key to success is in building an efficient exploration strategy balancing between exploration (test new states), exploitation (replay actions known to lead to high rewards). Using deep neural networks to encode the decision process as lead to significant progress. This is often referred as Deep Reinforcement Learning (DRL). A classical benchmark where DRL thrives are ATARI games. The most visible success of DLR is probably AlphaZero that outperformed the best human players (and itself) after being trained without using data from human games but solely through reinforcement learning. The process requires an advanced infrastructure for the training phase. For instance AlphaZero trained during more than 70 hours using 64 GPU workers and109 CPU parameter servers for playing 4.9 million games of generated self-play, using 1,600 simulations for each Monte Carlo Tree Search.

The general workflow is the following. To speed up the learning process and enable a wide but thorough exploration of the parameter space, the learning neural network interacts in parallel with several instances of actors, each one consisting of a simulation of the task being learned and a neural network interacting with this simulation through the best winning strategy it knows. Periodically the actor's networks are updated by the learned neural network. This workflow has evolved through various research works combining parallelisation, asynchronism, replay buffers and learning strategies (GORILLA, A3C, IMPALA,...).

Latest developments have shown that mass parallelism is a key enabler to address complex problems. The RLlib framework is designed to automatically distribute RL environments at scale. Google/Deepmind recent announcement of the Menger framework goes in the same direction.

The goal of this postdoc is to investigate how to combine massive parallelism and training strategies to learn more rapidly and more complex tasks (multiple heterogeneous tasks at once, non deterministic games, simulations of complex industrial or living systems). This postdoc is very flexible on the directions it can take. We expect that the candidate bring its own experience and view on these topics. Focus can address (not limited): 1) addressing middleware and system issues in deploying and running very large scale DRL 2) developing novel parallelisation algorithms for some of the DRL components (replay buffer, mode/data parallel training) 3) application of DRL as an adaptive strategy for smart parametric search space exploration for ensemble run based scenarios like data assimilation, hyperparameter search, uncertainty quantification 4) developing improved or novel learning rules specifically designed for large scale where lossening synchronisation requirements are critical

This work will be performed in close collaboration in between the SCOLL INRIA team specialised in reinforcement learning ([https://team.inria.fr/scoll](https://team.inria.fr/scoll)) and the DataMove team specialised in HPC ([https://team.inria.fr/datamove](https://team.inria.fr/datamove)). Datamove and SCOLL are involved in an INRIA group focused on the convergence between HPC, AI and Big Data ([https://project.inria.fr/hpccbigrdata](https://project.inria.fr/hpccbigrdata)). The candidate will participate to that group too.

The SCOLL (formerly Sequel) team is leading research group on reinforcement learning, either deep or not, ranging from theoretical aspects to applications. For instance SCOLL organised the international Summer School on RL in 2019 ([https://rl.iris.inria.fr](https://rl.iris.inria.fr)). Among other projects, SCOLL has collaborated with Mila (Montréal) to design and develop the Guesswhat? experiment ([https://guesswhat.ai](https://guesswhat.ai)).

**Informations générales**

- **Thème/Domaine :** Calcul distribué et à haute performance  
- **Ville:** St Martin d'Hères  
- **Centre Inria :** CRI Grenoble - Rhône-Alpes  
- **Date de prise de fonction souhaitée :** 2021-10-01  
- **Durée de contrat :** 2 ans  
- **Date limite pour postuler :** 2021-07-09

**Contacts**

- **Equipe Inria :** DATAMOVE  
- **Recruteur :** Raffin Bruno / bruno.raffin@inria.fr

**A propos d'Inria**

Inria est l'institut national de recherche dédié aux sciences et technologies du numérique. Il emploie 2600 personnes. Ses 200 équipes-projets agiles, en général communes avec des partenaires académiques, impliquent plus que 3500 scientifiques pour relever les défis du numérique, souvent à l'interface d'autres disciplines. L'institut fait appel à de nombreux talents dans plus d'une quarantaine de métiers différents. 500 personnels d'appui à la recherche et à l'innovation contribuent à faire émerger et grandir des projets scientifiques ou entrepreneuriaux qui impactent le monde. Inria travaille avec de nombreuses entreprises et a accompagné la création de plus de 180 start-up. L'institut s'efforce ainsi de répondre aux enjeux de la transformation numérique de la science, de la société et de l'économie.

**Consignes pour postuler**

**Important information concerning the COVID-19 epidemic:** in case the rules by the French government and Inria related to the epidemic make it impossible for the candidate to physically start the position at Inria Grenoble, the position will start with teleworking.

**Sécurité défense :**  
Ce poste est susceptible d'être affecté dans une zone à régime restrictif (ZRR), telle que définie dans le décret n°2017-1425 relatif à la protection du potentiel scientifique et technique de la nation (PPST). L'autorisation d'accès à une zone est délivrée par le chef d'établissement, après avis ministériel favorable, tel que défini dans l'arrêté du 03 juillet 2012, relatif à la PPST. Un avis ministériel défavorable pour un poste affecté dans une ZRR aurait pour conséquence l'annulation du recrutement.

**Politique de recrutement :**  
Dans le cadre de sa politique diversité, tous les postes Inria sont accessibles aux personnes en situation de handicap.

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**Attention :** Les candidatures doivent être déposées en ligne sur le site Inria. Le traitement des candidatures adressées par d'autres canaux n'est pas garanti.
early as 2006, SCOLL worked on go game and designed the first go program (Crazy Stone) able to challenge a human expert player (https://www.remi-coulom.fr/CrazyStone/).

Datamove has a long experience on high performance computing and data analytics https://hal.archives-ouvertes.fr/hal-01221186. Datamove is also developing the Melissa (https://melissa-sa.github.io/) solution to manage large ensembles of parallel simulations and aggregate their data on-line in a parallel server. Melissa stands out by its flexibility, efficiency and resilience. Melissa enabled to run tens of thousands of simulations on up to 30 000 cores. Melissa as been used for computing statistics, train deep surrogate models. We expect it to be a sound base for a DRL workflow.

References:
Google Menger: https://ai.googleblog.com/2020/10/massively-large-scale-distributed.html
AlphaGoZero: https://deepmind.com/blog/alphago-zero-learning-scratch/
TensorFlow: https://www.tensorflow.org/
Impala https://arxiv.org/abs/1802.01561
Elf https://arxiv.org/abs/1707.01047
Melissa: https://hal.inria.fr/hal-01607479v1

Principales activités
We are looking for a candidate with a PhD either related to high performance computing, deep learning, reinforcement learning (a combination of these expertise would be ideal) for a 24 month contract at INRIA. The candidate will have the possibility to join either the SCOLL team at Lille or the Grenoble Team at Grenoble.

The postdoc will have access to large supercomputers equipped with multiple GPUs for experiments. We expect this work to lead to international publications sustained by advanced software prototypes.

Avantages
- 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 up to two days per week 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

Rémunération
Salary: 2 653 € gross/month.
Monthly salary after taxes: around 2 136,39 € (medical insurance included, income tax excluded).