Offre n°2023-06913

Internship - Reinforcement Learning for Stochastic Resource Allocation in 6G Networks

Le descriptif de l'offre ci-dessous est en Anglais

Type de contrat : Stage

Niveau de diplôme exigé : Bac + 5 ou équivalent

Fonction : Stagiaire de la recherche

A propos du centre ou de la direction fonctionnelle

The Inria research centre in Lyon is the 9th Inria research centre, formally created in January 2022. It brings together approximately 300 people in 16 research teams and research support services. Its staff are distributed at this stage on 2 campuses: in Villeurbanne La Doua (Centre / INSA Lyon / UCBL) on the one hand, and Lyon Gerland (ENS de Lyon) on the other. The Lyon centre is active in the fields of software, distributed and high-performance computing, embedded systems, quantum computing and privacy in the digital world, but also in digital health and computational biology.

Contexte et atouts du poste

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MARACAS (Models and Algorithms for Reliable Communication Systems) team is joint team with Inria Lyon and INSA Lyon, active in wireless communications, information theory and statistical signal processing. MARACAS investigates on recent results from learning and artificial intelligence and their adaptation to multi-user communication systems. The team is hosted in the CITI laboratory of the Telecommunication Department of INSA Lyon.

We propose an internship at the crossroad of machine learning and telecommunications, seeking to apply reinforcement learning techniques to resource allocation problems. The internship will be supervised by PhD student Alix Jeannerot and Pr. Jean-Marie Gorce, head of MARACAS team.

Mission confiée

Context:

Internet of things (IoT) networks as well as 6G networks are expected to support a much higher number of devices compared to current networks. A key challenge of the deployment of such network is to avoid as much as possible collision between packets of the different devices. To this end, it is crucial to make a better utilization of the available resources (frequency band, time slots, power level...) that can be used for transmissions.

Currently, in wireless network, before transmitting data, devices need to ask for a grant (an exclusive allocation of resources) to the base station, and once they have this authorization, they can transmit data on the resources. This scheme is well suited is the device has lots of data to send or receive (for example, performing a video call). However in the context of Internet of Things, the transmission of the request of a grant can be longer than the actual data the device wants to send (for example, a smart sensor sending a temperature), making this scheme inefficient. A protocol, better suited for IoT networks, called grant free random access (GFRA) has been proposed and shows improvement in the energy efficiency of the devices. This protocol relies on the widely used assumption that devices in the network are equally likely to transmit and are statistically independent of each other. But this assumption is not holding in most of practical cases.

Assignment:

The objective of this internship, is, in line with some previous work done in our team, to investigate the
possibility of modifying the GFRA protocol in order to exploit the different probability of transmissions or the possible correlation between devices. To this end, we wish to use reinforcement learning techniques to learn which resources should be assigned to which devices.

**Objective:**

The first step of the internship will be to formalize a reinforcement learning problem, where the environment, actions, rewards and states are clearly defined. Based on that, different algorithms (policy gradient, Q learning...) for solving RL problems will be tested and evaluated. Comparisons with the commonly used methods for resource allocation will also be carried. If time permits and depending on the wishes of the intern, either a mathematical regret analysis of the algorithms or an implementation of the proposed algorithms on the experiment platform of the lab (Cortex Lab) can be considered.

**Principales activités**

Main activities :
- Survey of state of the art and identification of possible solutions.
- Formalization of optimization problems
- Implementation of different algorithms

Additional activities (3 maximum) :
- Write report

**Compétences**

We are looking for a Master's student (engineering school or university) pursuing a degree in computer science, telecommunications or electrical engineering for a duration of 4-6 month. Starting date and end date are flexible.

Technical skills :
- Programming in Python
- Knowledge in Machine Learning and/or Telecommunications (knowledge of both fields is not mandatory)

Languages :
- English and/or French

**Avantages**

- Subsidized meals
- Partial reimbursement of public transport costs
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities

**Rémunération**

Minimum legal gratification

**Informations générales**

- **Thème/Domaine** : Réseaux et télécommunications
- **Système & réseaux** (BAP E)
- **Ville** : Villeurbanne
- **Centre Inria** : Centre Inria de Lyon
- **Date de prise de fonction souhaitée** : 2023-03-01
- **Durée de contrat** : 6 mois
- **Date limite pour postuler** : 2024-02-11

**Contacts**

- **Équipe Inria** : MARACAS
- **Recruteur** :
  Jeannerot Alix / ali.x.jeannerot@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 215 équipes-projets agiles, en général communies avec des partenaires académiques, impliquent plus de 3900 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. 900 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 200 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.

**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.

**Consignes pour postuler**

Applications must be submitted online on the Inria website.

Processing of applications sent by other channels is not guaranteed.

**Sécurité défense :**
Ce poste est susceptible d’être affecté dans une zone à régime restrictif (ZRR), telle que définie dans le décret n°2011-1425 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.