



Offre n°2024-08203

Post-Doctoral Research Visit F/M

Resource allocation and scheduling for data stream processing in shared Fog environments

Type de contrat : Fixed-term contract

Niveau de diplôme exigé : PhD or equivalent

Fonction : Post-Doctoral Research Visit

A propos du centre ou de la direction fonctionnelle

The Inria Centre at Rennes University is one of Inria's eight centres and has more than thirty 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, etc

Contexte et atouts du poste

Financial and working environment

This post-doctoral position is part of the PEPR Cloud - Taranis project funded by the French government (France 2030). The position will be recruited and hosted at the Inria Center at Rennes University; and the work will be carried out within the MAGELLAN team in close collaboration with the DiverSE team and other partners in the Taranis project.

Mission confiée

Context:

The mutual low-latency objective for both Data Stream Processing (DSP) and Fog environments has resulted in a continuous growth of DSP deployments on Fogs [1]. However, the success of the deployment and running of stream data applications in the Fog relies on how to efficiently allocate resources and schedule tasks (operators) to achieve the desired performance. Previous efforts on deploying

stream data applications in the Fog have focused on reducing the volume of communication overhead between nodes (inter-node communication) and dividing the computation between Fog servers and Clouds [2, 3]. Unfortunately, they are oblivious to (1) the dynamic nature of data streams (i.e., data volatility and bursts) and to (2) the bandwidth and resource heterogeneity in the Fog, which negatively affects the performance of stream data applications [4][5].

Objectives:

The goal of this postdoc project is to investigate how to optimize resource and task allocation when deploying data streaming processing applications in the Fog. In particular, we want to investigate new optimization metrics and objectives when deploying streaming processing applications in the Fog, including latency, throughput, and maximum sustainable throughput. Accordingly, we will develop a new scheduling framework that relies, among others, on Machine Learning/Deep Learning models to decide on resource allocation and operator placement at runtime (based on the collected data and given the cost model of redeployment and process migration). The proposed framework will be integrated in one of state-of-the-art data stream engines such as Flink [6], Storm [7] or Spark [8] and evaluated at large-scale using syntactic applications and real-world stream data application.

References :

- [1] Noghabi, Shadi A., Landon Cox, Sharad Agarwal, and Ganesh Ananthanarayanan. "The emerging landscape of edge computing." *GetMobile: Mobile Computing and Communications* 23, no. 4 (2020): 11-20.
- [2] Nardelli, Matteo, Valeria Cardellini, Vincenzo Grassi, and Francesco Lo Presti. "Efficient operator placement for distributed data stream processing applications." *IEEE Transactions on Parallel and Distributed Systems* 30, no. 8 (2019): 1753-1767.
- [3] Renart, Eduard Gibert, Alexandre Da Silva Veith, Daniel Balouek-Thomert, Marcos Dias De Assunção, Laurent Lefevre, and Manish Parashar. "Distributed operator placement for IoT data analytics across edge and cloud resources." In *2019 19th IEEE/ACM International Symposium on Cluster, Cloud and Grid Computing (CCGRID)*, pp. 459-468. IEEE, 2019.
- [4] Lambert, Thomas, David Guyon, and Shadi Ibrahim. "Rethinking operators placement of stream data application in the edge." In *Proceedings of the 29th ACM International Conference on Information & Knowledge Management*, pp. 2101-2104. 2020.
- [5] Aarsalane, Khaled, Guillaume Pierre, and Shadi Ibrahim. "Toward Stream Processing Elasticity in Realistic Geo-Distributed Environments." In *IC2E 2024-12th IEEE International Conference on Cloud Engineering*, pp. 1-9. 2024.
- [6] "Apache flink," <https://flink.apache.org>.
- [7] Apache Storm. 2020. <https://storm.apache.org/>
- [8] Zaharia, Matei, Tathagata Das, Haoyuan Li, Timothy Hunter, Scott Shenker, and Ion Stoica. "Discretized streams: Fault-tolerant streaming computation at scale." In *Proceedings of the twenty-fourth ACM symposium on operating systems*

Principales activités

- Read and synthesize literature work.
- Design new resource allocation and scheduling policies for data stream processing in the Fog.
- Implementation and large-scale validation.
- Participate in project meetings and discussions with other partners.
- Write research papers and disseminate results through presentations at project meetings, conferences, and workshops.

Compétences

- A Ph.D. in computer science
- A solid background in the area of distributed systems
- Ability to conduct experimental systems research
- Experience with building systems and tools
- Working experience in the areas of Big Data management, Cloud Computing, Data Analytics are advantageous
- Very good communication skills in oral and written English

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 (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

Rémunération

he postdoctoral researcher will receive a gross monthly salary of 2,788 euros.

Informations générales

- **Thème/Domaine** : Distributed Systems and middleware System & Networks (BAP E)
- **Ville** : Rennes
- **Centre Inria** : [Centre Inria de l'Université de Rennes](#)
- **Date de prise de fonction souhaitée** : 2024-12-01
- **Durée de contrat** : 1 year, 6 months
- **Date limite pour postuler** : 2025-09-28

Contacts

- **Équipe Inria** : [MAGELLAN](#)
- **Recruteur** :
Ibrahim Shadi / Shadi.Ibrahim@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 communes 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

Please submit online : your resume, cover letter and letters of recommendation eventually.

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.