2021-04221 - Handling code variability in HPC application: application to a bioinformatic application

Type de contrat : CDD
Niveau de diplôme exigé : Thèse ou équivalent
Fonction : Chercheur contractuel

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 located 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

Numerical simulation is a key technology for many application domains. Thanks to the democratization of high performance computers (HPC), complex physics and more generally complex systems can now be simulated routinely. Numerical simulation is considered as the third pillar of sciences (with experiment and theory) and is critical to gain competitive position. HPC aims at maximizing performance of an application on a given architecture.

The classical optimization work flow is based on identifying hot spots or bottlenecks and on optimizing them. Natural design of HPC applications reflects this model where a set of basic building blocks is identified for its performance penalties if not optimized.

However, such approach does not ensure performance portability except for well identified kernels [1]. It does not address issues related to the whole software stack where several serious limitations occur. First, the complexity of hardware and applications imposes coordination of experts to select the best combination of algorithms and hardware for a given problem. Second, an algorithm may also impose new representations of data type which can impose time consuming code refactoring and data layout could also be dependent of the architecture. Third, composition of several basic building blocks may deliver low performance due to bad resources sharing at runtime.

To achieve portable high performance, efficiently chaining algorithms and/or data structures becomes unavoidable, but it is very complex and takes a lot of time (of refactoring of years or decades old of legacy application). Moreover, co-design of software stack and application targeting parallel architectures to reach high performance raises several challenges. At the bottom level, architectures become more and more complex to program because micro-architecture requires more and more in-depth knowledge to be understood. At the middle level, the distribution of the applications on massively parallel hardware becomes unmanageable. At the top level, composing algorithmic variants of modern codes to enable more efficient applications is still an open challenge.

Mission confiée

The recruited person will contribute to a methodology to answer the question of how to productively achieve high level of performance of complex software in presence of code evolutions and architecture variations for domain developers. A major scientific objective of the project is then to propose a programming model that enables flexible and maintainable HPC applications to make them robust to code evolutions and architecture variations. This model could be based on an extension of the COMET component model [2] which enables to express and manipulate the application structure but with a limited expressivity. Moreover, we anticipate that such a model will need to extend features from existing runtime models such as OpenMP. Hence, a second scientific objective is to improve OpenMP-like runtime models to better report execution performance and behavior.

The recruited person will work in an stimulating environment in the AVALON team located in the LIP at ENS de Lyon. She will be in connection with the BEAGLE team that brings the Aevol case study [3].


Principales activités

- Propose a model superseding COMET to support the abstractions needed for Aevol
- Propose improvement to OpenMP-like runtimes to support such a model
- Develop a proof of concept of the proposed approach
- Conduct an evaluation of the proof of concept

Compétences

Technical skills and level required:

- very good knowledge of HPC programming models and runtimes (e.g. OpenMP)
- good programming skills (Python and C++)
- knowledge in (meta-)modeling will be appreciated

Avantages

Informations générales

- Thème/Domaine : Calcul distribué et à haute performance
- Calcul Scientifique (BAP E)
- Ville : Lyon
- Centre Inria : CRI Grenoble - Rhône-Alpes
- Date de prise de fonction souhaitée : 2022-02-01
- Durée de contrat : 12 mois
- Date limite pour postuler : 2022-01-30

Contacts

- Equipe Inria : AVALON
- Recruteur : Perez Christian / christian.perez@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 agissent, en général communes avec des partenaires académiques, impliquent plus de 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. 900 personnels d'appui à la recherche et à l'innovation contribuent à faire émerger et grandir des projets scientifiques ou entrepreneuriaux qui impacteront 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

Sécurité défense :

Le 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'autorisations 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.

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.
- 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 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