

Post-doctoral position : Visualisation of parallel evolutionary algorithms

Context

This one year post-doctoral position is funded by an ANR-Emergence project, EASEA-CLOUD. The aim of the EASEA-CLOUD project is to exploit the massively parallel resources that are offered by clusters or a grid of modern GPU-equipped machines in order to find solutions to inverse problems whose evaluation function can be intrinsically sequential. Massive parallelization of generic sequential problems can be achieved by evolutionary computation, that can efficiently exploit the parallel evaluation of thousands of potential solutions (a population) for optimization or machine-learning purposes. The project consists in turning the existing EASEA (EAsy Specification of Evolutionary Algorithms, <http://lsiit.u-strasbg.fr/easea>) research platform into a platform that could be exploited by running in « cloud » mode, on a large grid of computers (ISC-PIF/CREA is the current manager of the French National Grid). The necessary steps are to develop :

- a professional-grade API, development environment and human-computer interface for the existing academic EASEA platform,
- cloud-management tools (in order to launch an experiment on a grid of computers, monitor the experiment and bill the laboratories or companies that will be using EASEA-CLOUD for intensive computation,
- **novel visualisation tools, in order to monitor an evolutionary run, potentially launched on several hundred heterogeneous GPU machines.**

The consortium is made of three partners : LSIIT/UDS (which is developing the EASEA platform), ISC-PIR/CREA (for its experience in grid and cloud computing), AVIZ/INRIA (for its experience in visualization tools for evolutionary computation) and two subcontractors : LogXLabs (a software development company in order to create industrial-grade code and interfaces) and BIOEMERGENCE-IMAGIF, the « valorisation » department of CNRS Gif s/Yvette. Valorisation will take place in strong collaboration with UNISTRA VALO, the valorisation structure of Université de Strasbourg.

Description of Work

When dealing with very complex structures of algorithms, distributed on heterogeneous clouds, the problem of monitoring and tuning an optimisation process is very complex. The settings and various data collected during a run represent a large amount of data, the challenge is then to be able to correctly collect, represent and display it, in order to let the end-user understand and interact with it. This problem is not new, and has common points with research focussed on experimental analysis of EA behaviour. If we now deal with a set of island populations, with sparse interactions, cooperatively running on various nodes of a cloud computer, one then has to deal with an even more complex dataset. The challenge is to be able to give a comprehensive view of what happens inside a cloud during computation. We have shown in recent papers [LF11a, LF11b] that two visualisation softwares of the infovis community, GraphDice and GeneaQuilts, developed in the AVIZ team[Nik08], can easily be used for visual inspection of EA behaviour. This preliminary study allowed identifying a set of desirable features to adapt these general visualisation tools to the specific needs of EA analysis. In the EASEA-CLOUD project, we will aim at adapting these tools for on-line visualisation of distributed EAs.

The post-doc will aim at developing a visualisation module for the EASEA language, adapted to the visualisation of data collected during a run of an evolutionary algorithm. The tasks will be the following :

- to collect on-line data to be visualised with minimal impact on computational efficiency : this point is particularly complex for parallel and cloud implementations,
- to design versatile performance measurements to allow an efficient monitoring of a variety of evolutionary algorithm schemes,
- to display off-line and on-line data in a comprehensive way (this task will be based on the use and adaptation of the GraphDice software of the AVIZ team),
- to allow interactions with the system (parameter tuning, stop or restart of unuseful islands, etc ...).

Besides its developmental part based on existing freewares (EASEA and GraphDice), the work opens important questions for experimental and theoretical analysis of evolutionary computation algorithms. For instance, structured view of on-line data may allow unconventional statistic analysis (like statistics on lineages associated to a specific operator). Associated to an adapted visualisation, such a tool may allow precise analysis of efficiency of various operators, strategies, or combination of operators.

Hosting lab

The student will be hosted in the AVIZ team of INRIA (<http://www.aviz.fr/>), at LRI (Bâtiment 650, PCRI, Université Paris-Sud, Orsay).

AVIZ is a multidisciplinary team of INRIA aiming at improving the analysis and visualization of large and complex datasets by combining analysis methods with interactive visualizations.

Supervisor

Evelyne LUTTON, INRIA, AVIZ team, Evelyne.Lutton@inria.fr

Prerequisite

The candidate that will be recruited will need to have a good experience in artificial evolution. Good programming skills are mandatory (java, C++), and prior experience in visual analytics will be appreciated.

To apply

Motivation letter and CV to be sent by e-mail to Evelyne.Lutton@inria.fr.

Références

- [LF11a] Evelyne Lutton and Jean-Daniel Fekete. Visual analytics and experimental analysis of evolutionary algorithms. Research Report RR-7605, INRIA, 04 2011.
- [LF11b] Evelyne Lutton and Jean-Daniel Fekete. Visual analytics of ea data. In *Genetic and Evolutionary Computation Conference, GECCO 2011*, 2011. July 12-16, 2011, Dublin, Ireland.
- [Nik08] Niklas Elmqvist and Pierre Dragicevic and Jean-Daniel Fekete. Rolling the Dice : Multidimensional Visual Exploration using Scatterplot Matrix Navigation. *IEEE Transactions on Visualization and Computer Graphics*, 14(6) :1141–1148, 2008. (Best Paper Award).