

Internship Subject 2009-2010

Applied Mathematics in Finance

Optimization Algorithms And Parallel Computing

Arbitragis Trading, Paris, France

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Abstract

Equity derivatives pricing and trading requires a massive amount of computation and a fairly good understanding of optimization techniques. Now that we are reaching the limits of the Moore law, a paradigm shift is needed in order to increase computations by orders of magnitude. Parallel computing is one way to solve the problem, but this requires a complete re-thought of applied mathematics. We are going to study different ways to parallelize well-known algorithms such as gradient descent algorithms and quadratic solvers.

Keywords: parallel computing, optimization, gradient descent, quadratic solvers, MPI, parallel design patterns, C++, multithreading, applied mathematics, GPU programming.

1 Who are we ?

Arbitragis Trading is a leader in quantitative trading. We build our own models and softwares in order to trade financial markets with a highly quantitative bias. Most of our trading is done by our computers that trade the markets without human intervention. Trading is done with our own capital, which allows us to be extremely creative in the Research and Development process.

We also like to maintain a close relationship with the academic world : we also teach computational finance at Ecole Centrale Paris [Click here for the schedule and the agenda.](#), and you will also take advantage of our research and vision.

2 Internship subject

We propose a choice of different algorithms that need to be parallelized either with MPI or through Cuda programming (on a Graphical Processing Unit). A very good mathematical knowledge of optimization is required and a very high interest in parallel computing is a must (MPI, Cuda or general multithreading).

3 Development Steps

- optimizations algorithms will be given and you will parallelize them,
- we will brief you on the way to use MPI and Cuda or some other parallel framework,
- you will test results on a HPC (High Performance Cluster) that will have the same power as Meteo France.

4 Tools Given by Arbitragis

Selected students will need to be extremely proficient in C++ and in Applied Mathematics. Ideally, they will have programmed more than 2000 lines of codes in C++ before coming.

5 What you will gain from this experience

You will gain a massive expertise in C++ and in quantitative finance that will be useful for your career as future Traders or developers of high-level financial applications. Your knowledge and understanding of derivatives will be extremely high. You will benefit from a very competent staff which will help you if you need so that you spend as little time possible.

Eventually, you will benefit from our trading methodologies, know-how, and vision. You will benefit from the expertise of a competent and available staff that will help you whenever you need. Our development methodologies based on agile programming and our expertise in financial markets will allow you to develop a superb application within an extremely short period of time.

Our alumni work in trading rooms at JP Morgan, SocGen, Citibank or BNP. Some continue their studies at El Karoui's DEA or Harvard.

6 How to apply ?

Please send a resume in PDF form only to stages@arbitragis.com. This document can also be found on <http://www.arbitragis-research.com>.

7 Who should apply ?

Students from Polytechnique, Ecole Centrale Paris, Mines de Paris, Ecoles des Ponts, Telecom Paris.

8 Internship dates

Dates are flexible starting from January 2010 or later, for 4 to 6 months.