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Global Markets

BNP Paribas Corporate & Institutional Banking (CIB) is a leading European investment bank with global leadership in many of our businesses. We are part of the BNP Paribas Group, a financial institution with solid foundations and a proven ability to adapt to change. If you are thinking about a career in investment banking, there is no better place to begin your journey than with BNP Paribas CIB. With nearly 20,000 employees in over 50 countries, we can offer you an exciting start to your career.

BNP Paribas's Global Markets Quantitative Research develops highly efficient and specialized systems at the heart of front office teams. We work at the finest level of financial market expertise, pricing models and market data knowledge.

Inside Quant Research team, "Histo" team works on a wide range of applications, from trade data analysis, real time price computation to market data storage and high performance transfer, and a wide range of tasks from algorithm design and refinement, user experience to hardware selection, advanced operating system usage and network performance analysis.

The Quant Research team is looking for an intern

Your profile:

- - broad understanding of computer science (and science in general)
- - being autonomous, open-minded, thinking outside the box
- - mastering several programming languages of various types
- - having a good knowledge of Linux ecosystem.

- You'll be offered the opportunity to develop systems that will really be used in production and have a strong impact. We also provide a very stimulating work environment, where your work will be challenged by our team members. We also offer autonomy and expect from you a great deal of initiative.

If you think you're the kind of intern we're looking for, please send your resume to
dl.candidat.eqd.research@bnpparibas.com
(Maxime Lenoir, Quant Research Team)

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- **Here below some examples of internships that we'll be offering this year which can be refined according to the intern's profile:**

- Internship: 5-6 months

Topic: **Display of historical and real-time intraday data**

Summary: The Quantitative Research team aggregates intraday data of millions of instruments, on a daily basis. We wish to be able to display those data easily. The goal of the internship is to study visualization and display methods and implement a solution that would allow us to plot a large volume of data (potentially in real-time). The intern will also focus on the user experience of the solution and its overall performance.

Keywords: UX, tick data, real-time

- Internship: 5-6 months

Topic: **Domain Specific Language for intraday data treatment**

Summary: Intraday data consumption usually follows the same pattern: a client receives a stream of messages on which post-treatment are applied (filtering, mapping, aggregation ...). This can lead to useless resource consumption and forces the end-user to reprocess the data on his side. Instead the user could upload a program on the server, describing the transformation to apply on the data. The goal of the internship is to study the various forms and methods to generate such a program. A particular effort is expected on the DSL ease-of-use, its fitness to answer usual intraday data treatment and the performance of the resulting program executed on the server.

Keywords: Domain Specific Language, compilation, JIT, big data

- Internship: 5-6 months

Topic: **System monitoring and anomaly detection**

Summary: The Quantitative Research team works with a large number of servers and services on a daily basis. Those systems can sometimes enter an unusual state. In order to facilitate the understanding of these issues, a monitoring system is used. The goal of the internship is to study and improve the current monitoring system. Beacons can be placed to measure the overall health of the system. An anomaly detection system will be designed to detect and predict incoming issues.

Keywords: Monitoring, Linux

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- **Here below some examples of past internships:**

- Intern: Sofian Medbouhi

Education: Supélec, ESCP

Internship: May to August 2016

Topic: **Consensus algorithms: distributed systems, fault tolerance and blockchains**

Summary: Distributed systems are at the heart of modern computer systems and can take many forms. Consensus algorithms lie are the theoretical foundation of such systems and can have various, sometimes incompatible properties. They can be encountered in topics ranging from distributed, replicated databases, to distributed anonymous ledgers like Bitcoin. Having a precise idea of the characteristics of classes of consensus algorithms is hard for non-experts. Sofian worked on describing consensus algorithms in terms of the basic invariants of distributed systems defined by Leslie Lamport, studying both classical algorithms like Paxos, engineering standards like RAFT, as well as techniques used in distributed ledgers like the Bitcoin blockchain. In addition to the qualitative, theoretical considerations, Sofian has worked on implementing a simulation engine for the behavior of component nodes of a distributed system, which yielded experimental results about the complexity and resource consumption of these algorithms.

Keywords: Distributed systems, network, graphs, blockchain

- Intern: Michael Tran

Education: Paris-Dauphine

Internship: May to October 2015

Topic: **Running applications and services in containers**

Summary: The Quantitative Research team develops a large number of programs and services of variable criticality and requirements. A key to scalability is the ability to run these services in such a way that they do not interfere with each other and minimize the impact of environment changes. The goal of the internship was to study isolation techniques in Linux-based operating systems and implement them in an easy-to-use system and to include administration tools as well as load balancing and optimization of resource allocation.

Keywords: Containers, Linux