Master student  
CHU Sainte-Justine Research Center

Principal Investigator(s)  
Joyal, Jean-Sébastien M.D., Ph.D.

Project duration  
2 years +

Start date  
January 2019

Research laboratory presentation
Our primary goal is to understand the mechanisms controlling changes in cell identity during development and disease progression, with a particular interest in the vascular system. For the last 3 years, new technologies to sequence RNA and DNA from individual cells have providing unprecedented insights into the biology of complex system. We use single cell genomic and transcriptomic data to reconstruct differentiation pathways, lineage hierarchies, and tissue heterogeneity in mouse and human organs, and any other system we find fascinating! The challenge is now to translate the multi-omics data generated for better understanding human physiology and potentially human disease, which will require intelligent approaches to detect patterns of significances. Our ultimate goal is to apply artificial intelligence to single-cell data for human diagnosis and personalized medicine (see links below):
http://stm.sciencemag.org/content/9/408/eaan4730.full
http://science.sciencemag.org/content/356/6335/eaah4573

Please contact us if you are interested in learning more about our research. We work at the intersection of many fields and are always looking for ambitious scientists with a background in developmental biology, bioinformatics and/or informatics.

Research project description
The project pertains to the development, maintenance and optimization of bioinformatics workflows within a HPC environment, focusing on the analysis of single-cell genomics data. You will work on different biological datasets, ranging from neurovascular development to pathological angiogenesis (the formation of “bad” blood vessel). You will explore single-cell epigenomics and transcriptomics data, infer gene regulatory networks, model single cell trajectories across pseudotimes, and study the impact of disease progression on gene regulation. Depending on your expertise, you can apply machine learning techniques or statistical/Bayesian data integration techniques. You can explore big data compendia such as the emerging single-cell atlases (Human Cell Atlas, Mouse Cell Atlas, etc.). Our biological field of study is broad, so you will have the opportunity to work on diverse cell types and biological phenomena ranging from stem cells and cancer metabolism; to central nervous system inflammation and aging.

Ultimately, you will be able to test and validate new methods and algorithms for the analysis of single-cell genomics data; to implement efficient pipelines and QC steps; and to benchmark different methods for the normalization, clustering, and visualization of single-cell data. You will also build cell atlases to create an online portal for data sharing. This position will involve regular interactions within a multidisciplinary network of researchers at the CHU Sainte Justine.
Depending on the outcome, this project would lead to the creation of a clinical bioinformatic platform for the integration of other sets of “omics” data.

**Required training and profile**

Our laboratory is seeking a highly motivated student who likes data, programming, machine-learning, and cloud computing.

**Essential**
- BSc in Bioinformatics, Computer Science or related field
- A computational mindset and a strong interest in computational biology
- Excellent programming skills in a subset of the following languages: Python, Perl, Java/C++, R/Shiny, with the knowledge of Linux/Unix, SQL, and version control, e.g. Git
- Experience with HPC or cloud computing (AWS)

**Desirable but not essential**
- Knowledge of open-source and proprietary computational biology tools and databases
- Experience in data mining and machine learning approaches
- Experience with the analysis of NGS and other high-throughput data; for example: WGS, Exome-seq, single cell, epigenomics, GWAS, eQTL, RNA-seq, ChIP-seq

**Conditions of internship**
- A versatile and challenging job with very diverse contacts in a world-class research environment operating at an international level, and various opportunities to broaden your expertise
- Project supervision by Medical Doctors and Computational Scientists, in collaboration with Calcul Quebec and Genome Quebec/Canada
- A renewable contract with competitive salary (**18 000 $ CAD/year**) and student benefits
- Financial support is available for at least 2 years. However, the successful candidate will be encouraged to obtain a personal fellowship

**Submit your application**

Both junior and senior applicants are welcome but previous experience with bioinformatics is required. Candidates must apply before January 2019. Interested candidates must submit the following documentation to gael.cagnone@umontreal.ca. (documents in French or English)

- ✔ Curriculum vitae
- ✔ Transcripts
- ✔ Cover letter
- ✔ References
Master student
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How is it like to study or make a fellowship at the CHU Sainte-Justine Research Center?
Pursue your graduate or postdoctoral studies at the CHU Sainte-Justine Research Center, and be one of the 385 students, fellows and interns who are helping to fast track the development of knowledge in the field of mother, child and adolescent health. Under the supervision of prominent scientists, especially in leukemia, rare pediatric diseases, genetics, perinatology, obesity, neuropsychology and cognition, scoliosis and rehabilitation, you will have the opportunity to work with multidisciplinary scientific teams and collaborators from all over the world.

About the CHU Sainte-Justine Research Center
CHU Sainte-Justine Research Center is a leading mother-child research institution affiliated with Université de Montréal. It brings together more than 200 research investigators, including over 90 clinician-scientists, as well as 385 graduate and postgraduate students focused on finding innovative prevention means, faster and less invasive treatments, as well as personalized approaches to medicine. The Center is part of CHU Sainte-Justine, which is the largest mother-child center in Canada and second most important pediatric center in North America. More on research.chusj.org