

PhD position at IFP Energies nouvelles (IFPEN) in Data science and Bioinformatics

Graph-based learning from integrated multi-omics and multi-species data (genomic, transcriptomic, epigenetic)

Micro-organisms are studied here for their application to bio-based chemistry from renewable sources. Such organisms are driven by their genome expression, with very diverse mechanisms acting at various biological scales, sensitive to external conditions (nutrients, environment). The irruption of novel high-throughput experimental technologies provides complementary omics data and, therefore, a better capability for understanding for the studied biological systems. Innovative analysis methods are required for such highly integrated data. Their handling increasingly require advanced bioinformatics, data science and optimization tools to provide insights into the multi-level regulation mechanisms.

The main objective of this subject is to offer an improved understanding of the different regulation levels in the cell (from model organisms to *Trichoderma reesei* strains). The underlying prediction task requires the normalization and the integration of heterogeneous biological data (genomic, transcriptomic and epigenetic) from different microorganisms. The path chosen is that of graph modelling and network optimization techniques, allowing the combination of different natures of data, with the incorporation of biological a priori (in the line of BRANE Cut and BRANE Clust algorithms). Learning models relating genomic and transcriptomic data to epigenomic traits could be associated to network inference, source separation and clustering techniques to achieve this aim. The methodology would inherit from a wealth of techniques developed over graphs for scattered data, social networks. Attention will also be paid to novel evaluation metrics, as their standardization remains a crucial stake in bioinformatics.

A preliminary internship position (summer/fall 2018) is suggested before engaging the PhD program. Information at: <http://www.laurent-duval.eu/lcd-2018-intern-phd-epigenetics-omics-graph-processing.html>

Previous works:

A. Pirayre, C. Couprie, L. Duval, F. Bidard, J.-C. Pesquet, 2015, BRANE Cut: [Biologically-Related A priori Network Enhancement with Graph cuts for Gene Regulatory Network inference](#), BMC Bioinformatics
D. Seux, F. D. Malliaros, A. Papadopoulos, M. Vazirgiannis, 2017, Core Decomposition of Uncertain Graphs Using Representative Instances, International Conference on Complex Networks and Their Applications
A. Pirayre, C. Couprie, L. Duval, J.-C. Pesquet, 2018, [BRANE Clust: cluster-assisted gene regulatory network inference refinement](#), IEEE/ACM Transactions on Computational Biology and Bioinformatics

Keywords: data integration, data science, graphs, omics data, optimization, machine learning

Academic supervisor	Pr PESQUET Jean-Christophe, CentraleSupélec/INRIA Saclay, Center for Visual Computing
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IFPEN supervisor	Dr DUVAL Laurent, laurent.duval@ifpen.fr ; Dr. BIDARD Frédérique
Supervising team	Dr MALLIAROS Fragkiskos ; Dr. PIRAYRE Aurélie
PhD location	IFP Energies nouvelles, Rueil-Malmaison, France
Duration and start date	3 years, starting preferably from October 1st, 2018
Employer	IFP Energies nouvelles, Rueil-Malmaison, France
Academic requirements	University Master degree in data science, bioinformatics, mathematics, computer and information sciences
Language requirements	Fluency in English
Other requirements	Knowledgeable in statistics and optimally in biological genetic mechanisms

For more information or to submit an application, see theses.ifpen.fr or contact the IFPEN supervisor.

About IFP Energies nouvelles

IFP Energies nouvelles is a French public-sector research, innovation and training center. Its mission is to develop efficient, economical, clean and sustainable technologies in the fields of energy, transport and the environment. For more information, see www.ifpen.fr.

IFPEN offers a stimulating research environment, with access to first in class laboratory infrastructures and computing facilities. IFPEN offers competitive salary and benefits packages. All PhD students have access to dedicated seminars and training sessions.