

Master project 2020-2021

Personal Information

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Project

Computational genomics

Project Title:

A dynamic epigenetic network

Keywords:

epigenetics; networks; bioinformatics

Summary:

The laboratory of Alfonso Valencia specializes in many areas of computational biology focusing on the integration of data and development of computational frameworks that could help bridge the gap between fundamental research and personalized medicine. One of the areas of expertise of the lab is epigenomics, producing pioneer studies in the field. The project will be mainly supervised by François Serra an expert in epigenetics and chromatin conformation (coauthor of the works mentioned below on leukemia and cell differentiation), with experience in mentoring master and PhD students. The project we propose here is based on the work of Vera Pancaldi that built an epigenetic network based on the 3D conformation of the chromatin (Pancaldi et al. 2016). We aim to reproduce this work using more genomic interaction data (Davies et al. 2017) and to study it in the dynamic models of leukemia and cell differentiation (Beekman et al. 2018) or cell dedifferentiation (Stadhouders et al. 2018). Concretely the student will work on the development of a computational pipeline to discover interactions between DNA binding proteins and epigenetic marks. Finally, the data will be represented as a network of interactions to be analyzed at different time stages. We expect to be able to understand the functional association between the different actors in the epigenetic landscape and to understand the dynamics behind its remodeling upon disease or in development. What you will learn: - Computational biology: basics on network analysis; collaborative software development using GIT; design and use of computational pipelines for high performance computing (in the 30th most powerful supercomputer in the world). - Epigenomics: explore available data in the interface between genomics and epigenomics, postulate hypotheses about the mechanisms of gene regulation, and analyze the results. - Scientific Dissemination: to present in lab meetings and to write a research article resulting from your work.

References:

Beekman, R., Chapaprieta, V., Russiñol, N., Vilarrasa-Blasi, R., Verdaguer-Dot, N., Martens, J.H.A., Duran-Ferrer, M., Kulis, M., Serra, F., Javierre, B.M., Wingett, S.W., Clot, G., Queirós, A.C., Castellano, G., Blanc, J., Gut, M., Merkel, A., Heath, S., Vlasova, A., Ullrich, S. and Martin-Subero, J.I. 2018. The reference epigenome and regulatory chromatin landscape of chronic lymphocytic leukemia. *Nature Medicine* 24(6), pp. 868-880. Davies, J.O.J., Oudelaar, A.M., Higgs, D.R. and Hughes, J.R. 2017. How best to identify chromosomal interactions: a comparison of approaches. *Nature Methods* 14(2), pp. 125-134. Pancaldi, V., Carrillo-de-Santa-

Pau, E., Javierre, B.M., Juan, D., Fraser, P., Spivakov, M., Valencia, A. and Rico, D. 2016. Integrating epigenomic data and 3D genomic structure with a new measure of chromatin assortativity. *Genome Biology* 17(1), p. 152. Stadhouders, R., Vidal, E., Serra, F., Di Stefano, B., Le Dily, F., Quilez, J., Gomez, A., Collombet, S., Berenguer, C., Cuartero, Y., Hecht, J., Filion, G.J., Beato, M., Marti-Renom, M.A. and Graf, T. 2018. Transcription factors orchestrate dynamic interplay between genome topology and gene regulation during cell reprogramming. *Nature Genetics* 50(2), pp. 238–249.

Expected skills::

1- Critical thinking and creativity 2- Good statistical and programming skills (R/Bioconductor or Python) 3 - Basic knowledge of molecular biology 4- Ability to access and evaluate scientific literature

Possibility of funding::

Yes

Possible continuity with PhD: :

To be discussed

Comments:

This project is a follow up of the work currently being done by a UPF master student. The new student will benefit from the results and analysis generated until now. It is also wide enough, biologically and methodologically, to leave room for the student to decide in which direction she/he would prefer to go in either way. The project will be supervised by François Serra and co-supervised by Alfonso Valencia.
