Universitat Pompeu Fabra Barcelona | Master in Bioinformatics for Health Sciences

Master project 2024-2025

Personal Information

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Project

Computational systems biology

Project Title:

Bayesian lung function trajectories, genomics and image analisis.

Keywords:

Trajectories, image analisis, epigenetics, transcriptomics

Summary:

This project builds on an ongoing collaboration between the two PIs one based in Barcelona and the second in Boston. Structural changes evident on chest imaging (CT, computed tomography scan) are associated with Chronic Obstructive Pulmonary Disease (COPD), and studies have shown that such changes may precede the functional (spirometric) impairment. Common measures capture disease processes such as emphysema and airway wall thickening; however, other, less explored measures exist that capture characteristics of pulmonary vasculature and extra-pulmonary measures such as skeletal muscle wasting and cardiac morphological changes. All these measures can be determined applying deep learning to CT scans. COPD is biologically hetereogeneous, and genomics tools have been applied to study such heterogeneity. Different epigenetics, transcriptomics, microbiome, signatures have been associated to the severity of the lung function impairemend, however its asociation with the imaging features, remains still under studied. Separately, a growing body of research has demonstrated that there are distinct lung function trajectories throughout the life-course, and that abnormal trajectories are associated with increased risk for developing COPD. Importantly, the interplay between functional trajectories, structural changes evident on CT, and the biological asociates are understudied. Our lab has generated quantitative imaging biomarkers for study participants. Likewise, we have identified spirometric trajectories that these participants belong to. And has produced the clinical and genomics data necessary to explore the mechanistic heterogeneity. In this role, you will apply traditional ML classification routines to identify salient imaging biomarkers for the task of classifying lung function trajectory category, and combine with transcriptomics, and epigenetics.

References:

Dysanapsis is differentially related to lung function trajectories with distinct structural and functional patterns in COPD and variable risk for adverse outcomes. Ross JC, San José Estépar R, Ash S, Pistenmaa C, Han M, Bhatt SP, Bodduluri S, Sparrow D, Charbonnier JP, Washko GR, Diaz AA. EClinicalMedicine (IF: 3.59; Q1). 2024 Jan 5;68:102408. doi: 10.1016/j.eclinm.2023.102408. eCollection 2024 Feb. PMID: 38273887 Longitudinal Modeling of Lung Function Trajectories in Smokers with and without Chronic Obstructive Pulmonary Disease. Ross JC, Castaldi PJ, Cho MH, Hersh CP, Rahaghi FN, Sánchez-Ferrero GV, Parker MM, Litonjua AA, Sparrow D, Dy JG, Silverman EK, Washko GR, San José Estépar R. Am J Respir Crit Care Med (IF: 21.41; Q1). 2018 Oct 15;198(8):1033-1042. doi: 10.1164/rccm.201707-1405OC. PMID: 29671603 Epigenome-Wide Association Studies of COPD and Lung Function: A Systematic Review. Casas-Recasens S, Cassim R, Mendoza N, Agusti A, Lodge C, Li S, Bui D, Martino D, Dharmage SC, Faner R. Am J Respir Crit Care Med (IF: 21.41; Q1). 2024 Feb 29. doi: 10.1164/rccm.202302-0231OC. Online ahead of print. PMID: 38422471 Lung immune signatures define two groups of end-stage IPF patients. Cruz T, Mendoza N, Casas-Recasens S, Noell G, Hernandez-Gonzalez F, Frino-Garcia A, Alsina-Restoy X, Molina M, Rojas M, Agustí A, Sellares J, Faner R. Respir Res (IF: 3.92; Q1). 2023 Sep 28;24(1):236. doi: 10.1186/s12931-023-02546-8. PMID: 37770891 Genetic and Epigenetic Associations with Pre-Chronic Obstructive Pulmonary Disease Lung Function Trajectories. Martino DJ, Bui DS, Li S, Idrose S, Perret J, Lowe AJ, Lodge CJ, Bowatte G, Moodley Y, Thomas PS, Zosky G, Hansbro PM, Holloway JW, Svanes C, Faner R, Walters EH, Dharmage SC. Am J Respir Crit Care Med (IF: 21.41; Q1). 2023 Nov 15;208(10):1135-1137. doi: 10.1164/rccm.202306-1025LE. PMID: 37610423

Expected skills:

Phyton, R, and motivation to learn different topics, in a collboration acros institutions in different countries.

Possibility of funding:

Yes

Possible continuity with PhD:

To be discussed

Comments:

Student will have to work online with the supervisor abroad, but it would be possible a stay.