From Data to Models:

Analyzing and Integrating Biological Data into Mechanistic Models

Dora Tortarolo, Simone Pernice, Francesca Cordero

Course of *Doctoral school*
PhD in Complex Systems for Quantitative Biomedicine

Who we are

Simone Pernice is currently assistant professor at the Department of Computer Science of the University of Turin, coordinator of Young InfoLife group of the Infolife National Laboratory of CINI. His current research activities mainly involve computational epidemiology, modeling of complex biological systems, and longitudinal data analysis.

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Simone Pernice

RTDA

Dora Tortarolo is currently a Post Doc at the Department of Computer Science of the University of Turin. Biologist by training, she pursued her PhD both at the biology lab bench and in the computer lab, receiving in 2022 her PhD degree in "Complex Systems for the Life Sciences" at the University of Turin. Currently, she focuses on the microbiome data analysis and modeling of complex biological systems.
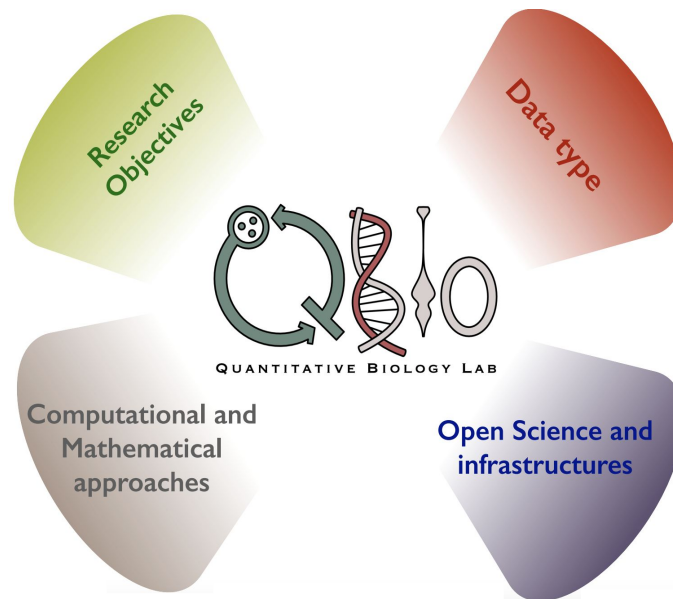
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Dora Tortarolo

Post Doc
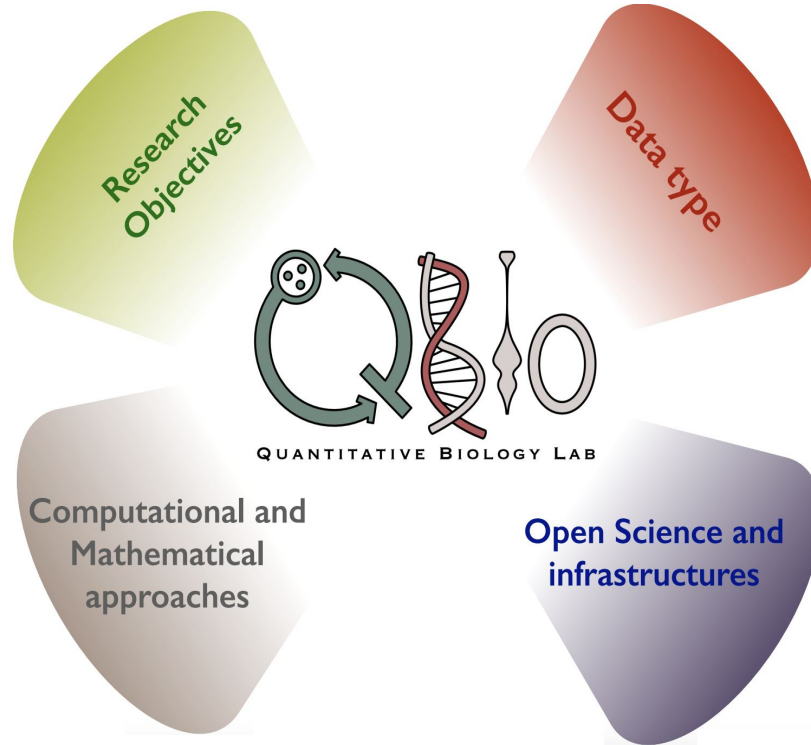
Who we are

Research Objectives:

- Patient stratification

- Identification of diagnostic and prognostic biomarkers

- Epidemiological models

- Mathematical models for cancer progression and treatment response

- Evolutionary Genomics and Modelling

- Basic Research: Cancer Genomics and Epigenomics

- Microbiome research: development of data analysis pipelines

When?

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
29	30	1	2	3	4 • 09:00 - 13:00 Sala Seminari 👤	5
6	7 • 09:00 - 13:00 Sala conferenze, terzo piano 👤	8	9	10	11 • 09:00 - 13:00 Sala Seminari 👤	12
13	14 • 09:00 - 13:00 Sala conferenze, terzo piano 👤	15	16	17	18	19

Course Outline

Day 1 – Introduction to Mechanistic Modeling and the Importance of Data

- Welcome and Course Introduction
- Overview of computational models in biology.
- Mechanistic approaches: conceptual foundations of Petri Nets and the *epimod* framework.
- Hands-on Activity: the Schlögl model to understand system dynamics and sensitivity.

Day 2 – From Case Study to Data Analysis

- From Data to Models: the importance of model parameterization using real (raw) experimental data.
- Real-World Case Study: understanding the problem context.
- Hands-on: Data Analysis using ORCA.
- Real-World Case Study: model definition.

https://github.com/qBioTurin/From-Data-to-Models.git

Day 3 – Calibration and Predictive Modeling

- Model Calibration: introduction to calibration techniques for mechanistic models.
- Predictive Simulations: Performing what-if analyses using calibrated models.
- Flux Balance Analysis: Principles and applications in systems biology.

Day 4 – Data Integration and Advanced Modeling

- Integrative Modeling: combining FBA with experimental data for enhanced predictions.
- Introduction to UnifiedGreatMOD: linking heterogeneous data to mechanistic and constraint-based models.
- Hands-on: FBA case study with data integration.
- Course Wrap-up: Summary of key concepts.

SCAN ME!