POLITECNICO DI MILANO

PhD in DATA ANALYTICS AND DECISION SCIENCES - 41st cycle

THEMATIC Research Field: COMPUTATIONAL MORPHOGENESIS

Monthly net income of PhDscholarship (max 36 months)
1750.0 In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	The objective of this project is to build a mechanistic model of morphogenesis, where we model virtual cells that communicate with each other through diffusion of molecules and mechanics only. Each cell's state (concentration of molecules) undergoes a reaction in each timestep (a virtual gene regulatory network). Some of the cell's molecules diffuse into the extracellular space and other cells can react to molecules in their vicinity. Cells decide independently, given their state, when and how to divide and distribute their molecules between the daughter cells. The goal is to develop this model and fit it to experimentally observed morphogenesis data to capture the dynamics of the system (embryogenesis or model organisms like C. elegans or organoids derived from human samples). Ideally, the model will allow us to interrogate the principles of inter-cell communication, intra-cell reaction networks, and to perform in-silico experiments for hypotheses generation.
Methods and techniques that will be developed and used to carry out the research	* probabilistic modelling * reinforcement learning * graph neural networks * live-cell image analysis (segmentation and tracking) * physics-informed modelling
Educational objectives	In this project, you will learn how to design and implement mechanistic models and how to apply them to real-world

	biomedical datasets. On a technical level, you will learn how to write efficient, maintainable, and well documented source code; as well as probabilistic modelling and deep learning in general. In addition to those technical skills, you will learn to communicate and translate between different expert domains.
Job opportunities	A successful model of morphogensis and more generally of cellular dynamics at the molecular level is of enourmous value to understand principles of gene regulation and cell-cell interaction. Those topics are of great interest in the biotech and pharma industries.
Composition of the research group	2 Full Professors 3 Associated Professors 3 Assistant Professors 16 PhD Students
Name of the research directors	Prof. F. Ieva (Polimi)/ Dr. J. Funke (HT)

Contacts
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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

Scholarship Increase for a period abroad	
Amount monthly	875.0 €
By number of months	12

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

List of Universities, Companies, Agencies and/or National or International Institutions that are cooperating in the research:
Health Data Science Center (Fondazione Human Technopole)

Additional support
Educational activities (purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences):
financial aid per PhD student per year:
1st year: max 2.378,25 euro per student
2nd year: max 2.378,25 euro per student
3rd year: max 2.378,25 euro per student

Teaching and lab assistantship: availability of funding in recognition of supporting teaching and lab activities by the PhD student.
Further support is available for students who engage in activities of teaching or additional lab duties coherent with their academic mission and doctoral training.
The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.

Computer availability:
1 st year:individual use
2 nd year: individual use
3 rd year: individual use

Desk availability:
1 st year:individual use
2 nd year: individual use
3 rd year: individual use