Tata Institute of Fundamental Research
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Internal Webinar

Cell decision-making in an uncertain environment: A theorist's perspective

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Cell decision-making is the art to understand cellular decisions in a complex microenvironment. Cells change their phenotype to adapt to the local microenvironment. At the level of a single cell, decision-making is well studied, but knowledge about cell decision-making at the multicellular level is still vague. Partly understanding the field of multicellularity, a principle so-called Least microEnvironmental Uncertainty Principle (LEUP) was formulated. So far, it has been used in different areas of biology. In this talk, we will try to understand the dynamics of the phenotype of a single cell inside a complex multicellular uncertain environment. We try to answer some simple questions, like how can we understand a phenotypic behaviour of a cell in a multicellular environment (without knowing the interaction among the cells in the neighbourhood)? Why does tissue differentiation over time become robust? Can we scramble microenvironmental information to understand cellular reprogramming phenomena? To answer the set of questions, we use our theory to formulate an agent-based model using Langevin's equations and build a stochastic thermodynamics framework. At last, we compare the theoretical results with the experimental datasets.

Wednesday, Aug 16th 2023

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