"Mapping the emergence of organ identities in time & space"

Abstract: In this talk we will present approaches to infer trajectories from single-cell data. We present Palantir, an algorithm that infers trajectories of differentiating cells by treating cell fate as a probabilistic process and leverages entropy to measure cell plasticity along the trajectory. Palantir generates a high-resolution pseudo-time ordering of cells and, for each cell state, assigns a probability of differentiating into each terminal state. We apply our algorithm to mouse embryo endoderm populations until midgestation. We characterize the transcriptional architecture that accompanies the emergence of the first (primitive or extra-embryonic) endodermal population and its sister pluripotent (embryonic) epiblast lineage. We uncover a relationship between descendants of these two lineages, in which epiblast cells differentiate into endoderm at two distinct time points-before and during gastrulation. Trajectories of endoderm cells were mapped as they acquired embryonic versus extra-embryonic fates and as they spatially converged within the nascent gut endoderm, which revealed these cells to be globally similar but retain aspects of their lineage history. We also present ATAC-velocity and demonstrate that incorporating ATAC-seq can both direct trajectories in the correct direction and also highlight the underlying regulators of this process.

Dr. Dana Pe'er is the Alan and Sandra Gerry endowed Chair, Chair of Computational and Systems Biology program, Director of the Alan and Sandra Gerry Center for Metastasis and Tumor Ecosystems and Director of SKI Single Cell Research Initiative. The Pe'er lab combines single cell technologies, genomic datasets and machine learning techniques to address fundamental questions addressing development, tumor heterogeneity, tumor plasticity, tumor immune interaction and metastatic transition, regulatory network function and how this is derailed in disease. To answer these and additional key questions in biomedicine, Dana has taken a leadership role in the Human Cell Atlas project, to characterize all cells in the human body, how they organize into tissues and how these function in health and disease. Dana is a Fellow in the International Society for Computational Biology, and a Packard Fellow in Science and Engineering. She is also recipient of a Burroughs Welcome Fund Career Award, NIH Director's New Innovator Award, NSF CAREER award, Stand Up 2 Cancer Innovative Research Grant, Overton award, NIH Director's Pioneer and Lenfest Distinguished Faculty Award, and an Ernst W. Bertner Memorial Award from MD Anderson.