



THE HONG KONG UNIVERSITY OF SCIENCE & TECHNOLOGY

Department of Mathematics

PHD STUDENT SEMINAR

CellART: a unified framework for extracting single-cell information from high-resolution spatial transcriptomics

By

Mr Yuheng CHEN

Abstract

Understanding how different cell types assemble into tissues and organs, as well as how they interact to transmit and receive biological signals, is essential for advancing biomedical and biological research. Recent advancements in spatial transcriptomics (ST) technologies have opened new avenues for investigating biological systems by achieving subcellular spatial resolution. Since cells are the fundamental units of life, extracting single-cell information from high-resolution ST data is crucial. However, existing ST platforms often capture sparse transcript counts per spot or measure only a limited number of genes, complicating the extraction of comprehensive single-cell information. In this study, we introduce CellART, a unified framework designed to extract single-cell information across diverse high-resolution ST platforms, including VisiumHD, Xenium, MERFISH, and Stereo-seq. By leveraging multimodal data, such as staining images, spatial transcriptomics data, and single-cell RNA sequencing references, CellART simultaneously performs cell segmentation and cell type annotation through a seamless integration of deep learning and probabilistic modeling. We demonstrate the efficiency, generalizability, and robustness of CellART across various high-resolution spatial transcriptomics platforms, capable of processing datasets containing millions of spots. Comprehensive experiments validate the biological relevance and accuracy of the recovered cellular information within spatial configurations. Notably, we highlight the utility of CellART in breast and colorectal cancer datasets, showcasing its ability to fully leverage high-resolution ST data. By enhancing cellular resolution, CellART facilitates the identification of transient cancer cell states and immune cell subtypes. Furthermore, CellART enables investigations into cancer-immune cell communication, uncovering both established interactions and novel ligand-receptor pairs. The outputs of CellART are compatible with widely used community tools, facilitating a variety of downstream analyses.

Date : 24 April 2026, Friday

Time : 11:00am

Venue : Room 2463 (Lifts 25/26)

All are Welcome!