LEI XIONG

+1(857) 230-2401 ⋄ Cambridge, MA
jsxlei@gmail.com ⋄ Google Scholar ⋄ www.xiong-lei.com

RESEARCH INTERESTS

My research interests lie in the development and application of innovative deep learning approaches to address complex biological questions. I am primarily focused on large-scale genomics data (e.g. single-cell, spatial genomics, genetic perturbation, genetics and epigenetics). To achieve this, I build models that effectively capture and interpret complex features behind the data, providing new insights into fundamental biological processes and mechanisms. Through my work, I aim to drive significant advances in the field of computational genomics, contributing to a better understanding of human health and disease.

EDUCATION

Tsinghua University Sep 2015 - Oct 2020
Ph.D., Computational Biology
Advisor: Prof. Qiangfeng Cliff Zhang

University of Science and Technology of China Sep 2011 - Jun 2015
B.S., Biology, Shitsan Pai Talent Program in Life Sciences
Advisors: Prof. Nieng Yan and Jianye Zang

PROFESSIONAL EXPERIENCE

Postdoctoral Associate Dec 2021 - Present
Computer Science and Artificial Intelligence Laboratory,
Massachusetts Institute of Technology
Broad Institute of MIT and Harvard
Advisor: Prof. Manolis Kellis

- Develop method scCLIP using Transformers with genome-specialized tokenization and contrastive learning to align multiomics
- Develop method Translatomer, a transformer-based, multimodal deep learning framework that predicts ribosome profile using DNA sequence and RNA-seq data

Research Assistant Nov 2020 - Mar 2021
Tsinghua University
Advisor: Prof. Qiangfeng Cliff Zhang

Ph.D. student Dec 2015 - Oct 2020
Tsinghua University
Advisor: Prof. Qiangfeng Cliff Zhang

- Develop method SCALEX that projects cells into a shared batch-invariant cell-embedding space for single-cell data integration
- Develop method SCALE that combines the deep generative variational autoencoder (VAE) framework with Gaussian Mixture Model for single-cell ATAC-seq analysis

- Develop method using graph diffusion on structure-enabled protein-protein interaction(PPI) network to identify cancer-driving mutations and drug targets (Bayer-Tsinghua Collaboration)

Undergraduate Exchange Researcher Jul 2014 - Aug 2015
Tsinghua University
Advisor: Prof. Nieng Yan

- Resolve the structure of human GLUT3 protein in complex with D-glucose at 1.5 Å resolution in an outward-occluded conformation.

Undergraduate Research Program Sep 2013 - Jun 2014
University of Science and Technology of China
Advisor: Prof. Jianye Zang

- Structure and function research of ubiquitin ligase TRAIP (TRAF-interacting protein).

Undergraduate Researcher Jan 2012 - Oct 2013
University of Science and Technology of China
International Genetically Engineered Machine (iGEM), USTC-China

- In situ transdermal vaccine delivery system with TD-1 polypeptide in Bacillus subtilis.

HONORS AND AWARDS

Honors

- **Outstanding Doctoral Dissertation**, Tsinghua University (Top 5%, selected in 2021) 2020
- **Outstanding Graduate**, Beijing (Top 5%, selected in 2021) 2020
- **Top 10 Advances of Bioinformatics in China** (selected in 2020) 2019
- **Top 10 Algorithms and Tools for Bioinformatics in China** (selected in 2020) 2019
- **iGEM Gold Medal**, USTC-China 2013

Fellowship

- **Outstanding Fellowship**,
  Beijing Advanced Innovation Center of Structure Biology, Tsinghua University (¥ 20 k) 2019
- **Innovation Fellowship**,
  Beijing Advanced Innovation Center of Structure Biology, Tsinghua University (¥ 30 k) 2016

Scholarship

- **Student Scholarship**, University of Science and Technology of China 2012-2013
- **Student Scholarship**, University of Science and Technology of China 2011-2012
- **Freshman Scholarship**, University of Science and Technology of China 2011

PUBLICATIONS

* for equal authorship, # for corresponding authorship.

1. **Xiong, L.**, Chen, T., Kellis, M. (2023). scCLIP: Multi-modal Single-cell Contrastive Learning Integration Pre-training. NeurIPS 2023 Workshop AI4Science.

2. **Xiong, L.***, Tian, K*., Li, Y., Ning, W., Gao, X., & Zhang, Q. C.$^{\#}$ (2022). Online single-cell data integration through projecting heterogeneous datasets into a common cell-embedding space. Nature Communications, 13(1), 6118.

3. Zhang, B.*, Zhang, Y.*, **Xiong, L.**, Li, Y., Zhang, Y., Zhao, J., Jiang, H., Li, C., Liu, Y., Liu, X., Liu, H., Ping, Y.-F., Zhang, Q. C., Zhang, Z., Bian, X.-W., Zhao, Y., & Hu, X. (2022). CD127 imprints functional heterogeneity to diversify monocyte responses in inflammatory diseases. The Journal of Experimental Medicine, 219(2). https://doi.org/10.1084/jem.20211191

4. **Xiong, L.**, Xu, K., Tian, K., Shao, Y., Tang, L., Gao, G., Zhang, M., Jiang, T., & Zhang, Q. C.$^{\#}$ (2019). SCALE method for single-cell ATAC-seq analysis via latent feature extraction. Nature Communications, 10(1), 4576.

5. Deng, D., Sun, P., Yan, C., Ke, M., Jiang, X., **Xiong, L.**, Ren, W., Hirata, K., Yamamoto, M., Fan, S., & Yan, N. (2015). Molecular basis of ligand recognition and transport by glucose transporters. Nature, 526(7573), 391–396.

MANUSCRIPTS IN PREPARATION

1. He, J*., **Xiong, L.**$^{*,\#}$, Shi, X., Li, C., Chen, K., Fang Q., Hu X., Li J., Kellis, M., Xiong, X$^{\#}$. Deep learning modeling of ribosome profiling reveals regulatory underpinning of translatome and interprets disease variants. (In submission)

2. **Xiong, L.**, Kellis, M. Inferring enhancer-gene links from single-cell multi-omics through attention. (In prepreration)

PRESENTATIONS

Invited talks

- SCALE: single-cell ATAC-seq analysis via latent feature extraction
  MAIB-talk, The Artificial Intelligence and Biomedicine Society (IHS) Mar 2023

- A generalizable transcriptional regulation model with single-cell multi-omic data
  Fabian Theis Lab, Helmholtz Munich, Germany August 2023

Posters

- A generalized deep learning model for regulatory relationship between epigenetics and transcriptome
  American Society of Human Genetics (ASHG), LA 2022

- scCLIP: Multi-modal Single-cell Contrastive Learning Integration Pre-training
  NeurIPS 2023 Workshop AI4Science, New Orleans 2023

ACADEMIC SERVICE

Reviewer for journal
Bioinformatics, BMC Bioinformatics, PLoS ONE, Big Data, Frontiers in Endocrinology

Reviewer for conference
AAAI 2023 Workshop on Representation Learning for Responsible Human-Centric AI
AMIA 2023 Annual Symposium
ICML CompBio 2023

Meta-Reviewer and Area Chair for conference
AAAI 2023 Workshop on Representation Learning for Responsible Human-Centric AI

RESEARCH MENTORING

- **Ashwini Suriyaprakash**, Undergraduate student at MIT — Feb 2023 - Present
  Project: Building the Gene Regulatory Network using Deep Learning
- **Akshay Attaluri**, Undergraduate student at MIT — Feb 2023 - Present
  Project: Using CNN-Transformer Hybrid Architecture on DNA Sequences to Predict Gene Expression
- **Jose A Cazares Torres**, Undergraduate student at MIT — Feb 2023 - Present
  Project: Machine Learning for Single Cell modeling
- **Richard Gu**, Undergraduate student at MIT — June 2023 - Present
  Project: Machine Learning and Modality Translation Between Multi-Omic Layers for Single Cell Data
- **Cem A Tepe**, Undergraduate student at MIT — Feb 2023 - June 2023
  Project: Using NLP models to learn the grammar of DNA sequences
- **Yash Agarwal**, Undergraduate student at MIT — Jan 2023 - June 2023
  Project: Using Contrastive Learning Methods to Integrate Single-Cell Multiomics Data
- **Philip W Li**, Undergraduate student at MIT — Feb 2023 - June 2023
  Project: Using language models to learn the grammar of DNA sequences.
- **Robin Xiong**, Undergraduate students at MIT — Apr 2023 - Aug 2023
  Project: Using graph neural network to build the gene regulatory network from single-cell data
- **Siyoung Kim**, Undergraduate students at MIT — Apr 2023 - Aug 2023
  Project: Application of cutting-edge deep learning techniques on single-cell genomics

TEACHING EXPERIENCE

- Kaufman Teaching Certificate Program, MIT — Fall 2023

REFERENCES

Prof. Qiangfeng Cliff Zhang (Ph.D. advisor)
Associate Professor, Tsinghua University

qczhang@tsinghua.edu.cn

Prof. Manolis Kellis (Postdoc advisor)
Professor, MIT
kellis-admin@mit.edu

Prof. Lei Hou (Postdoc colleague)
Assistant Professor, Boston University
leihou@bu.edu