Yuqi Lei

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EDUCATION

- **Brown University** — Providence, RI
  Master of Science in Computer Science, pathway in Computational Biology; — *Aug 2022 - May 2024*
- **Jilin University** — Changchun, China
  Bachelor of Science in Computer Science — *Sep 2018 - Jun 2022*

RESEARCH EXPERIENCE

- **Brown University, Center for Computational Molecular Biology** — Providence, RI
  Research Assistant under the Guidance of Prof. Ritambhara Singh — *Apr 2023 - May 2024*

  ○ **Objective**:
  Enhance Transformer-based neural network performance for interpolating and extrapolating cell distributions in scRNA-seq data.

  ○ **Enhanced VAE with Attention Mechanism**:
  Integrated an attention mechanism into the Variational Autoencoder (VAE) for efficient dimension reduction of sparse scRNA-seq data. Achieved superior performance benchmarks compared to ZINB-WaVE and scVAE, evidenced by improved Pearson and Spearman correlation coefficients.

  ○ **Optimal Transport Loss Implementation**:
  Implemented Optimal Transport loss in both VAE and Transformer models, enhancing their ability to model cell differentiation. Comparative assessments against metrics like the Kolmogorov–Smirnov test and MSE revealed a more accurate representation of cell and gene distributions.

  ○ **Hyperparameter Optimization**:
  Developed a multi-faceted loss function combining L0, L1, and reconstruction losses. Employed Optuna for hyperparameter tuning, optimizing the coefficients to address cringing distribution issues in OT loss and enhancing variance in cell and gene distributions.

  ○ **Benchmark Visualization**:
  Created a visualization toolkit for benchmarking model performances. This tool facilitates comparative analyses across various metrics, grouping models by distinct characteristics and assisting in the generation of graphical data for upcoming research publications.

- **Jilin University, College of Computer Science** — Changchun, China
  Research Assistant under the Guidance of Prof. Ying Li — *Mar 2021 - Dec 2021*

  ○ **Objective**:
  Worked on optimizing OCGNN, an anomaly detection model to find the abnormal nodes in a graph.

  ○ **Graph Attention Network Implementation**:
  Re-engineered the model by adding attention layer after each convolution layer in the Graph Convolutional Network (GCN) to learn a "normal score" for each edge, enhancing the graph embeddings.

  ○ **Anomaly Detection with SVDD**:
  Leveraged Support Vector Data Description (SVDD) for latent space analysis, effectively identifying and rectifying mislabeled books that had been inaccurately recommended to students.

  ○ **Computationally Effective**:
  Implemented weight quantization techniques to accelerate calculations without compromising on the model's accuracy rate. The model reaches AUC score 85%, better than the baseline 73% with 50% extra training time.

INDUSTRY EXPERIENCE

- **OPPO Mobile Telecommunications Co.** — Shenzhen, China
  Algorithm Engineer under the Guidance of Dr. Ray Wang — *Jun 2021 - Aug 2022, 1yr 3mos*

  ○ **Knowledge Distillation for Mobile Deployment**:
  * Used Tensorflow to design a distilled CNN with jump connection and trained alongside original model for enhanced efficiency.
  * Devised a composite loss function combining cross-entropy, MSE loss, and edge loss between distilled and original model.
  * Performed iterative experimentation to find the optimal model architecture and loss weight settings
  * The Distilled model can transform a VGA resolution picture to 1080P within 2 seconds on mobile, and is integrated in the ColorOS.
  * Transformed the model into TensorflowLite, packed as a C++ SDK, and built an Android App demo, empowering OPPO engineers to seamlessly test and adapt machine learning models.
  * This project has became a part of the cloud-based image processing service.

  ○ **Neural Network Cross-Compilation Toolkit**:

* Constructed a Python toolkit incorporating <u>TVM</u> for neural network model optimization and cross-compilation.
  * The toolkit converts a TensorFlow model into optimized TensorFlowLite binary file with the selected platform-specific constraints and compilers.
  ○ **Model Management System for Federated Learning**:
    * Architected an Android App utilizing <u>Socket Programming</u> and <u>OKhttp</u> for dynamic model life cycle management.
    * The system facilitated the efficient edge training and periodic synchronization of pre-trained deep learning models, all coordinated via a server-client architecture.

PROJECTS

- **scCST: Interpolating Continuous Cellular Dynamics through Time** Deep Learning in scRNA-seq   Oct 2023

  Explored several dimension reduction methods like <u>scVAE</u> and <u>ZINB-WaVE</u> to generate latent cellular representation. Deployed the <u>Jonker-Volgenant Algorithm</u> to match cells between time points.
  Implemented a spatial-temporal continuous Transformer, scCST, utilizing scRNA-seq dataset to interpolate gene expression profiles between pseudo-time. Deployed the <u>Sobolov loss</u> that defines the derivative of the model. Optimizing Sobolov loss helps the model to learn the smooth representation in the feature space. This model solve the understanding of cellular dynamics in various developmental stages or conditions.

- **MOUSE: Modelling Omitted Unexpected Stimuli Easily** Deep Learning in Comp Neuro   Aug 2023

  Utilized the <u>Allen Visual Behavior dataset</u> to investigate expectation violations in VISp neurons. Developed a <u>Transformer-based</u> model, preprocessed with a <u>Kalman filter</u>, to predict these violations. Achieved 74% accuracy, outperforming traditional methods like MLP(70%) and SVM(68%). Employed SST and VIP cell firing rates to detect abnormal stimulus omission.

- **The Foolproof Eyes** Deep Learning in Brain   May 2023

  *Won **Best overall presentation award** in Prof. Singh's Deep Learning course.*
  Headed a team to enhance an <u>EfficientNet-based</u> model's robustness against white-box adversarial attacks. Integrated a <u>VOneBlock</u> based on primate V1 region to simulate the human primary visual cortex. Fine-tuned the <u>Garbor Filter Bank</u> parameters and analyzed the VOneBlock's components for maximal impact.
  Increased accuracy from 47% to 75% and bolstered resistance to white-box adversarial attack using <u>FGSM</u>.

- **Optimization of the Landau-Vishkin Algorithm** Dynamic Programming in Comp Bio   Dec 2022

  Reconstruct the <u>Landau-Vishkin</u> algorithm for pattern-text alignments with permissible discrepancies.
  Integrated the <u>Ukkonen algorithm</u> for efficient suffix tree construction, Transformed the <u>Lowest Common Ancestor</u> component into a <u>Range Minimum Query</u> problem within the Euler Tour,
  Made the algorithm complexity to $O(N)$ in preprocess and $O(NK)$ for alignment.

COMPETITION AWARDS

- Bronze Medalist (rank 9/93) - 2023 ICPC North America Regional Contest (Northeast Site)   Nov 2023
- **Finalist - 2023 ICPC North America Championship (ICPC-NAC)**   May 2023
- Silver Medalist (rank 6/84) - 2022 ICPC North America Regional Contest (Northeast Site)   Feb 2023
- Honorable Mention, Mathematical Contest In Modeling   Apr 2021
- Silver Medalist (rank 8/87) - China Collegiate Programming Contest (Northeast site)   Nov 2020
- Bronze Medalist - ICPC Asia Regional Contest (Mianyang Site)   Nov 2020
- Gold Medalist (rank 2/78) - 2020 ICPC Jilin Provincial Programming Contest   Oct 2020
- Gold Medalist - China Undergraduate Mathematical Contest in Modeling   Mar 2020
- Bronze Medalist - ICPC Asia Regional Contest (Qinhuangdao Site)   Nov 2019

HONORS

- Merit Student (top 5%, equal to Dean's List) - Jilin University, College of Computer Science   Sep 2020
- Excellent Student Leader - Jilin University   Sep 2019
- The First-class Scholarship (top 5%) - Jilin University   Sep 2019
- Scholarship for Academic Performance (top 3%) - Jilin University   Sep 2019

EXTRACURRICULAR ACTIVITIES

- **Brown University, Teacher Assistant** 2023-2024

  Serving as a teacher assistant for the course CSCI 1410: Artificial Intelligence taught by Prof. Stefanie Tellex.

- **Jilin University, Programming Contest Varsity** 2019-2021

  Wrote and reviewed programming problems for school-level ACM competitions. Maintained the online judge machines and hosted algorithm presentations for team members.

- **Jilin University, English Debate Club (JLU-EDC)** 2019-2021

  Served as <u>vice president</u> to organized debates, host annual contest, and prepare topics for round table discussions.