**Haoyun Lei**

E-mail: [haoyunl@andrew.cmu.edu](http://haoyunl@andrew.cmu.edu) **|** Phone: +1(412)969-3798

LinkedIn: [linkedin.com/in/haoyunlei/](file:///E:\Users\Leo\Dropbox\intern\linkedin.com\in\haoyunlei)  **|**  Website: <https://leovam.github.io/>

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| **EDUCATION** |
| **Ph.D. in Computational Biology Aug 2016 – May 2021**  Joint Carnegie Mellon-University of Pittsburgh Ph.D. Program in Computational Biology **(**expected)  Computational Biology Department, School of Computer Science  **Carnegie Mellon University (CMU), Pittsburgh, PA, USA**  **Advisor: Dr. Russell Schwartz**  **Research Interests: bioinformatics, machine learning, algorithm, discrete optimization, tumor phylogeny, sequencing**  **B.S. in Biological Science Sep 2008 – June 2012**  College of Life Science and Technology  **Huazhong University of Science and Technology (HUST), Wuhan, China** |
| **SKILLS** |
| **Programming Languages: Python (proficient), R (fluent), MATLAB (fluent), Shell (fluent), Java (familiar)** **Technical Skills and Tools: Bioinformatics (GATK, SAMtools,bedtools CNVkit etc.), Machine Learning (Sklearn), Deep**  **Learning (PyTorch, TensorFlow), Data Analysis (Numpy, Scipy), Data Visualization (Matplotlib, Seaborn, ggplot2),**  **Combinatorial Optimization (Gurobi, SCIP), Cloud Computing (AWS), Web Development (HTML/CSS/JS)** |
| **EXPERIENCE** |
| Ph.D. Project: Integrating multiple data types to infer tumor evolution (Python, R, MATLAB)May 2017 - Present   * Create a mixed membership model for the **Non-negative Matrix Factorization (NMF)** problem * Develop an efficient **coordinate descent algorithm** to solve the NMF problem in **Python** * Design a **Mixed Integer Linear Programming Model** with the popular optimization solvers of **Gurobi** and **SCIP** * Reach **~95% accuracy** with only small set of data and no other existing methods could do this   Benchmarking CNV detection tools (Python, R, Perl) Summer 2020   * Tested and compared public CNV detection tools for calling CNVs in targeted NGS data with a very small panel * Explored combinations of parameters of tools to increase true positive detection * Designed algorithms to rescue and recover CNVs with a weaker signal in a very small panel of targets * Reached over **94%** in sensitivity while kept specificity around **90%**   Converting free-text patient data to ICD codes using natural language processing (Pytorch, TensorFlow) Summer 2020   * Explored language models to annotate and chunk the important information in LabCorp’s patient medical text * Fine-tuned **BERT** model on ICD-10 code classification at chapter and block (first three characters) level * Designed a **two-step BERT** model to predict multiple ICD-10 codes in LabCorp’s patient medical text * Managed to work on a small dataset and reached **84%** in chapter level clarification   Detection of cancer types and relevant features using deep learning with RNA-seq data (Pytorch)Spring 2020   * Designed and fine-tuned **1D CNN**, **2D CNN** and a **hybrid CNN** models to detect cancer types * Designed a **Stacked Denoising Autoencoder Classifier** to improve the detections (**~96% accuracy**) * Applied **embedding** method to find implicit relationships between cancer samples and genes   Footprint Match and Pattern Detection using Machine Learning (Python)Spring 2017   * Classified ~ 10,000 feature matrices with **Neural Network** and **SVM** using **scikit-learn (~95% accuracy)** * Applied the **Scale-invariant feature transform (SIFT)** algorithm to match of saved and new images * Extracted the image patterns with **K-Means** and **Gaussian Mixture Model**   Predict Proto Genes using **Logistic Regression, Naïve Bayes Classifier** and **Decision Tree** Spring 2017  Copy Number Extraction from DNA Sequencing Data with **Numpy**, **Scipy** and **Regular Expression**  Fall 2016  Model gene regulatory network by combining **Boolean network** and **Ordinary Differential Equation** models Fall 2016 |
| **TEACHING EXPERIENCE** |
| **Algorithm and Advanced Data Structure Aug 2019 – present**  **Algorithms: Breadth-first Search, Depth-first Search, Binary Search, Quick Sort, Merge Sort etc.**  Data Structure: Linked List, Graph, Tree, Stack, Queue, Heap, ArrayList, Hash Table etc.  Concepts: Recursion, Dynamic Programming, Time and Space Complexity, NP-problem etc.  **Laboratory Methods for Computational Biologists** Aug 2018 – April 2019  Designed a faster pipeline combining multiple new analysis tools to detect differentially expressed genes in RNA-seq data |
| **BIBLIOGRAPHY** |
| **Articles**  Tao, Y., **Lei, H.**, Fu, X., Lee, A. V., Ma, J., and Schwartz, R. (2020). Robust and accurate deconvolution of tumor  populations uncovers evolutionary mechanisms of breast cancer metastasis.  ISMB2020, *Bioinformatics, 36,* i407-i416,  **Lei, H**., Lyu, B., Gertz, E., Schӓffer, A., Shi, X., Wu, K., Li, G., Xu, L, Hou, Y., Dean, M., and Schwartz, R. (2020).  Tumor Copy Number Deconvolution Integrating Bulk and Single-Cell Sequencing Data.  RECOMB 2019, *Journal of Computational Biology, 27(4)* 565-598.  Tao, Y., **Lei, H.**, Lee, A. V., Ma, J., and Schwartz, R. (2020). Neural Network Deconvolution Method for Resolving  Pathway-Level Progression of Tumor Clonal Expression Programs with Application to Breast Cancer Brain Metastases.  *Frontiers in Physiology, 11*, 1055.  **Lei, H.**, Gertz, E. M., Schäffer, A. A., Fu, X., Tao, Y., Heselmeyer-Haddad, K., … and Schwartz, R. (2020). Tumor  heterogeneity assessed by sequencing and fluorescence in situ hybridization (FISH) data.  *bioRxiv*  Tao, Y., **Lei, H.**, Lee, A. V., Ma, J., and Schwartz, R. (2019). Phylogenies derived from matched transcriptome reveal the  evolution of cell populations and temporal order of perturbed pathways in breast cancer brain metastases.  ISMCO 2019 *(pp. 3-28). Springer, Cham*.  **Abstracts & Talks**  **Lei, H.**, Gertz, E. M., Schäffer, A. A., Fu, X., Tao, Y., Heselmeyer-Haddad, K., … and Schwartz, R. (2020, July). Tumor  heterogeneity assessed by sequencing and fluorescence in situ hybridization (FISH) data.  ISMB, virtual  Fu, X., **Lei, H.**, and Schwartz, R. (2020, July). Joint Clustering of single cell sequencing and fluorescence in situ  hybridization data to infer tumor copy number phylogenies.  ISMB, virtual.  **Lei, H**., Lyu, B., Gertz, E., Schӓffer, A., Shi, X., Wu, K., Li, G., Xu, L, Hou, Y., Dean, M., and Schwartz, R. (2019, May).  Tumor Copy Number Deconvolution Integrating Bulk and Single-Cell Sequencing Data. International Conference on  Research in Computational Molecular Biology (RECOMB), Washington, DC.  **Lei, H**., Lyu, B., Gertz, E. M., Schӓffer, A. A., & Schwartz, R. (2018, October). Tumor Copy Number Data Deconvolution  Integrating Bulk and Single-cell Sequencing Data. In *2018 IEEE 8th International Conference on Computational Advances*  *in Bio and Medical Sciences (ICCABS)*, Las Vegas, NV.  **Lei, H.,** Roman, T., Eaton, J., and Schwartz, R. (2018, July). Deconvolution of tumor copy number data using bulk and  single-cell sequencing data. Conference on Intelligent System for Molecular Biology (ISMB), Chicago, IL.  **Lei, H.,** Roman, T., Eaton, J., and Schwartz, R. (2018, April). New directions in deconvolving genomics mixtures of copy  number variation data. SIAM Conference on Discrete Mathematics, Denver, CO. |
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