CONTACT INFORMATION	Department of Computer Science Princeton University Princeton, NJ USA	website: willtownes.github.io email: ftownes@princeton.edu

SUMMARY

I am a postdoctoral researcher working in biomedical data science with Dr. Barbara Engelhardt. I use probabilistic machine learning to gain insights into genomics, neuroscience, and ecology, with a particular focus on scalability and interpretability. I am also interested in spatial statistics, infectious disease, and economics. My goal is to produce statistical methods and open source software implementations to help scientists achieve their research goals more effectively.

EDUCATION

2019   **Ph.D. Biostatistics**, Harvard University, Cambridge, MA USA
     Doctoral Committee: Dr. Rafael Irizarry (Dana-Farber Cancer Institute, Data Science)
                     Dr. Jeff Miller (Harvard University, Biostatistics)
                     Dr. Martin Aryee (Massachusetts General Hospital, Pathology)

2013   **M.S. Mathematics & Statistics**, Georgetown University, Washington, DC USA
2007   **B.S. Biology**, Washington & Lee University, Lexington, VA USA

PROFESSIONAL EXPERIENCE

2019 - present   **Postdoctoral Researcher**, Princeton Computer Science Department

2011 - 2014   **Software Test Engineer**, SRA International, Arlington, VA
Developed automated testing of web services and ETL processes for the Energy Star Qualified Product Exchange. Trained other testers on the use of APIs and version control.

2008 - 2010   **Software Analyst**, Perrin Quarles Associates, Charlottesville, VA
Supported development of the Environmental Protection Agency's National Emissions Inventory System.

2007 - 2008   **Fulbright Scholar**, University of the Philippines
Conducted independent forest ecology research while living with an indigenous *Aeta* community in Bataan Province.

RESEARCH

In Review

[1] **Townes FW**, Engelhardt BE. Nonnegative spatial factorization (2021).
Preprint: `https://arxiv.org/abs/2110.06122`.

[2] Gewirtz ADH, **Townes FW**, and Engelhardt BE. Telescoping bimodal latent Dirichlet allocation to identify expression QTLs across tissues (2021).
Preprint: doi:10.1101/2021.10.27.466156.

[3] Verpeut JL, Bergeler S, Kislin M, **Townes FW**, Klibaite U, Dhanerawala ZM, Hoag A, Jung C, Lee J, Pisano TJ, Seagraves KM, Shaevitz JW, Wang SSH. Cerebellar contributions to a brainwide network for flexible behavior (2021).

In Press

[1] Jones A, **Townes FW**, Li D, Engelhardt BE. Contrastive latent variable modeling with application to case-control sequencing experiments. *Annals of Applied Statistics* (2021).
Preprint: `https://arxiv.org/abs/2102.06731`.

Peer-reviewed Journal Articles

[1] Hecker J, **Townes FW**, Kachroo P, Lasky-Su J, Ziniti J, Cho MH, Weiss ST, Laird NM, Lange C. A unifying framework for rare variant association testing in family-based designs, including higher criticism approaches, SKATs, and burden tests. *Bioinformatics* (2020).
doi:10.1093/bioinformatics/btaa1055.

[2] **Townes FW**, Carr K, Miller JW. Identifying longevity associated genes by integrating gene expression and curated annotations. *PLOS Computational Biology* (2020). doi:10.1371/journal.pcbi.1008429.

[3] **Townes FW**, Irizarry RA. Quantile normalization of single-cell RNA-seq read counts without unique molecular identifiers. *Genome Biology* (2020). doi:10.1186/s13059-020-02078-0.

[4] **Townes FW**, Hicks SC, Aryee MJ, Irizarry RA. Feature selection and dimension reduction for single-cell RNA-Seq based on a multinomial model. *Genome Biology* (2019). doi:10.1186/s13059-019-1861-6.

[5] Marsh DM, **Townes FW**, Cotter K, Farroni K, McCreary K, Petry R, Tilghman J. Thermal Preference and Species Range in Mountaintop Salamanders and Their Widespread Competitors. *Journal of Herpetology* (2019). doi:10.1670/18-110.

[6] Hicks SC, **Townes FW**, Teng M, Irizarry RA. Missing Data and Technical Variability in Single-Cell RNA-Sequencing Experiments. *Biostatistics* (2018). doi:10.1101/025528.

[7] Hecker, J, Xu X, **Townes FW**, Fier HL, Corcoran C, Laird N, Lange C. Family-Based Tests for Associating Haplotypes With General Phenotype Data: Application to Asthma Genetics. *Genetic Epidemiology* (2017). doi:10.1002/gepi.22094.

[8] Valeri L, Patterson-Lomba O, Gurmu Y, Ablorh A, Bobb J, **Townes FW**, Harling G. Predicting Subnational Ebola Virus Disease Epidemic Dynamics from Sociodemographic Indicators. *PLOS One* (2016). doi:10.1371/journal.pone.0163544.

[9] **Townes W**. Seed dispersal of the genus Leea in forest patches of Bataan, Philippines. *Ecotropica* (2010).

Technical Reports

[1] **Townes FW**. Review of Probability Distributions for Modeling Count Data. *arXiv* (2020). https://arxiv.org/abs/2001.04343.

[2] **Townes FW**. Generalized Principal Component Analysis. *arXiv* (2019). https://arxiv.org/abs/1907.02647.

TALKS

Invited Talks

[1] Emerging Concepts in Microbial Informatics, Molecular Medicine and Biotechnology (panelist). Trinity University of Asia. November 2021.

[2] Don't Normalize: the GLM-PCA approach to normalization. *Normjam*, *New York Genome Center*. November 2019.

[3] Biostatistics and Data Science as a Career Path. *Biology Department, Washington & Lee University*. October 2019.

Contributed Talks

[1] Nonnegative process factorization for multivariate spatial count data. *Joint Statistical Meetings* (virtual conference). August 2021.

[2] Quantile normalization of single-cell RNA-seq read counts without unique molecular identifiers. *Joint Statistical Meetings* (virtual conference). August 2020.

[3] Dimension reduction for massive single-cell datasets. *Bioconductor Annual Meeting* (virtual conference). July 2020. slides doi:10.7490/f1000research.1118084.1

[4] Dimension Reduction for Single Cell RNA-Seq based on a Multinomial Model. *Joint Statistical Meetings* (Denver, CO). August 2019.

[5] Varying-Censoring Aware Matrix Factorization for Single Cell RNA-Sequencing. *Bioconductor Annual Meeting* (Boston, MA). July 2017.

Seminars

[1] Nonnegative spatial factorization. *Hansen and Hicks labs, Department of Biostatistics, Johns Hopkins Bloomberg School of Public Health.* November 2021.

[2] Primer: Generalized linear models and latent factor models. *Broad Institute Models, Inference, and Algorithms.* October 2020.

[3] Feature Selection and Dimension Reduction for Single Cell RNA-Seq. *Greene Lab, Department of Systems Pharmacology and Translational Therapeutics, Perelman School of Medicine, University of Pennsylvania.* February 2019.

[4] Unsupervised Learning for Single Cell Gene Expression. *Harvard Biostatistics Cancer Working Group.* September 2018.

[5] Single Cell Housekeeping Genes and Normalization. *Dana-Farber Cancer Institute cBio Seminar.* April 2018.

[6] Informative Missing Data in Single Cell RNA-Seq. *Dana-Farber Cancer Institute Genomics Seminar.* October 2016.

[7] Family Based Association Tests for Rare Variants. *Brigham & Women's Hospital Channing Network Medicine Seminar.* September 2015.

Posters

[1] Townes FW, Shukla C. Gene Expression Autoencoders. Harvard Biomedical Informatics 707 (Deep Learning in Healthcare). April 2018.

[2] Townes FW, Marquez-Luna C. Mixture of Experts Analysis of Infectious Disease Outbreak Characteristics. Harvard Computer Science 281 (Advanced Machine Learning). December 2015.

[3] Townes FW, Karaayvaz M, Gillespie S, Bernstein B, Ellisen L, Aryee M. Single Cell RNA-Seq Technical and Biological Confounders. Program in Quantitative Genomics Conference, Harvard Medical School. November 2015.

Peer Review	**Journals**: *Bioinformatics, Biostatistics, Genome Biology, NAR Genomics and Bioinformatics, Nature Communications*

TEACHING EXPERIENCE	2021 Fall	**Guest lecture**, Advanced Computational Genomics (Princeton - COS 597D)
	2020 Fall	**Guest lecture**, Computational Biology of Single Cells (Princeton - COS 597F)
	2018 Fall	**Teaching Assistant**, Applied Regression (Harvard - BST 210)
		Grade homeworks, hold office hours, and teach a weekly lab section.
	2018 Summer	**Co-Instructor**, StatStart (Harvard)
		Statistics program for under-represented high school students.
		Gave two interactive lectures on graphing data and regression.
	2017 Fall	**Teaching Assistant**, Applied Bayesian Analysis (Harvard - BST 228)
		Grade homeworks, provide solutions, and hold office hours.
	2017 Summer	**Lead Instructor**, Introduction to Data Science (PARSE Ltd.)
		Nonprofit, week-long statistics program for high school students.
		Developed course material and gave interactive lectures using R.
	2017 Spring	**Teaching Assistant**, Applied Longitudinal Analysis (Harvard - BST 226)
		Grade homeworks and hold office hours.
	2016 Fall	**Teaching Assistant**, Intro to Statistical Methods (Harvard - BST 201)
		Grade homeworks, provide solutions, hold office hours, and teach a weekly lab section.
	2016 Summer	**Project Mentor**, Pipelines into Biostatistics (Harvard)
		Program for under-represented undergraduates.
		Guided three students on a pharmacogenomics data analysis.
	2016 Spring	**Teaching Assistant**, Rates and Proportions (Harvard - BST 210)
		Grade homeworks, provide solutions, hold office hours, and teach a weekly lab section.

SOFTWARE PACKAGES

[1] **glmpca**: dimension reduction for non-normally distributed data. R package: `https://cran.r-project.org/package=glmpca`, python package: `https://pypi.org/project/glmpca/`

[2] **scry**: Small-Count Analysis Methods for High-Dimensional Data. Bioconductor R package: `https://bioconductor.org/packages/release/bioc/html/scry.html`

[3] **quminorm**: Quantile normalization of non-UMI single cell read counts. R package: `https://github.com/willtownes/quminorm`

TECHNICAL SKILLS

Programming: R, Python, SQL, Git, LaTeX, Shell
Operating Systems: Mac OS X, Linux, Windows
Machine Learning Frameworks: Caret, Sklearn, Keras, Tensorflow, Stan