Jean Fan

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Education

Harvard University, Division of Medical Science — Boston, MA
PhD Candidate in Bioinformatics and Integrative Genomics — *June 2013 – Present*

Johns Hopkins University, Whiting School of Engineering — Baltimore, MD
Bachelors of Science in Biomedical Engineering and Applied Math — *Aug. 2009 – May 2013*

Montgomery Blair High School, Magnet Program — Silver Spring, MD
High School Diploma — *Aug. 2009 – May 2009*

Research Support

- **F99CA222750 (PI: Jean Fan)** — Award amount: $50,000 USD annually
  NIH NCI F99/K00 — *2017-current*
  - Title: Statistical Methods for Characterizing Tumor Heterogeneity at the Single Cell Level

- **F31CA206236 (PI: Jean Fan)** — Award amount: $34,000 USD annually
  NIH NCI F31 — *2016-2017*
  - Title: Computational Analysis of Subclonal Evolution in Chronic Lymphocytic Leukemia

- **DGE144152 (PI: Jean Fan)** — Award amount: $46,000 USD annually
  NSF GRFP — *2013-2016*

Research Experience

Department of Biomedical Informatics, Harvard Medical School — Boston, MA
Graduate Research Scientist — *July 2013 – Present*
- Mentored by Peter Kharchenko; In collaboration with Catherine Wu

Broad Institute — Boston, MA
Rotation Student — *Sept. 2013 – Nov. 2013*
- Mentored by Nir Hacohen and Catherine Wu

Harvard-MIT HST and i2b2 BIG Program — Boston, MA
Summer Undergraduate Research Intern — *June 2012 – Aug. 2012*
- Mentored by Shamil Sunyaev

Institute for Computational Medicine, Johns Hopkins University — Baltimore, MD
Undergraduate Research Scientist — *Aug. 2009 – May 2013*
- Mentored by Rachel Karchin

National Cancer Institute, National Institutes of Health — Bethesda, MD
Summer High School Research Intern — *June 2008 – Oct. 2008*
- Mentored by Paul Meltzer and Liang Cao

Publications

First and Co-first Author Publications

- **Fan J***, Lee H*, Lee S, Ryu D, Lee S, Kim SJ, Kim K, Park P, Park WY, Kharchenko PV. Linking transcriptional and genetic tumor heterogeneity through allele analysis of single-cell RNA-seq. (manuscript in preparation). J.F. conceived the study, lead the design and implementation of the software, and wrote the manuscript.

- **Fan J**, Fan D, Slowikowski K, Gehlenborg N, Kharchenko PV. UBiT2: a client-side web-application for gene expression data analysis. (manuscript in preparation; preprint available: http://biorxiv.org/content/early/2017/03/22/118992). J.F. conceived the study, lead the design and implementation of the software, and wrote the manuscript.

- Lake B*, Chen S*, Sos B*, **Fan J***, Yung Y, Kaeser GE, Duong TE, Gao D, Chun J*, Kharchenko PV*, Zhang K*. Integrative single-cell analysis by transcriptional and epigenetic states in human adult brain. (manuscript in preparation; preprint available: http://biorxiv.org/content/early/2017/04/19/128520). J. F. helped write the manuscript, and performed the single-cell gene expression and DNA accessibility analyses.

- Wang L*, **Fan J***, Zhang CZ, Francis JM, Georghiou G, Hergert S, Shuqiang Li, Gambe R, Zhou CW, Yang C, Xiao S, Cin PD, Bowden M, Kotliar D, Shukla SA, Brown JR, Neuberg D, Alessi DR, Khachenko PV, Livak KJ, Wu CJ. Integrated single-cell genetic and transcriptional analysis suggests novel drivers of chronic lymphocytic leukemia. Genome Research July 2017. doi:10.1101/gr.217331.116. J.F. helped design the study and write the manuscript, and performed gene expression and single-cell analyses.

- Wang L*, Brooks AN*, **Fan J***, Wan Y*, Gambe R, Li S, Hergert S, Yin S, et al. Transcriptomic characterization of SF3B1 mutation reveals its pleiotropic effects in chronic lymphocytic leukemia. Cancer Cell 2016, Nov 3. doi: 10.1016/j.ccell.2016.10.005. J.F. helped design the study and write the manuscript, as well as performed gene expression and single-cell analyses.

- **Fan J**, Salathia N, Liu R, Kaeser G, Yung Y, Herman J, Kaper F, Fan JB, Zhang K, Chun J, and Kharchenko PV. Characterizing transcriptional heterogeneity through pathway and gene set overdispersion analysis. Nature Methods 2016 Mar;13(3):241-4. doi: 10.1038/nmeth.3734. J.F. helped design and implement the statistical analysis approach and write the manuscript.

- **Fan J**, Slowikowski K. NAMCShiny: an interactive web application to explore health trends in 2003-2010 National Ambulatory Medical Care Survey data. HHPR 2015. J.F. conceived the study, lead the design and implementation of the software application, and wrote the manuscript.

- **Fan J**, Yu Y, Meltzer PS, Cao L. Delineating the Role of BRF2 in Breast Cancer Pathogenesis. HURJ 2011. 14, 53-55. J.F. helped carry out experiments and write the manuscript.

Other Publications

- Zhang X, Chen MH, Wu X, Kodani A, **Fan J**, Doan R, Ozawa M, Ma J, Yoshida N, Reiter JF, et al. Cell-Type-Specific Alternative Splicing Governs Cell Fate in the Developing Cerebral Cortex. Cell. 2016;166 (5) :1147-1162.e15. doi:10.1016/j.cell.2016.07.025. J.F. performed the single-cell analyses.

- Burger JA*, Landau DA*, Taylor-Weiner A*, Bozic I*, Zhang H*, Sarosiek K, Wang L, Stewart C, **Fan J**, Hoellenriegel J, Sivina M, Dubuc AM, Fraser C, Han Y, Li S, Livak KJ, Zou L, Wan Y, Konoplev S, Sougnez C, Brown JR, Abruzzo LV, Carter SL, Keating MJ, Davids MS, Wierda WG, Cibulskis K, Zenz T, Werner L, Dal Cin P, Kharchencko P, Neuberg D, Kantarjian H, Lander E, Gabriel S, O'Brien S, Letai A, Weitz DA, Nowak MA, Getz G, Wu CJ. Clonal evolution in patients with chronic lymphocytic leukemia developing resistance to BTK inhibition. Nature Communications 2016, May 20. doi: 10.1038/ncomms11589. J.F. performed the single-cell analyses.

- Landau DA, Clement K, Ziller MJ, Boyle P, **Fan J**, Gu H, Stevenson K, Sougnez C, Wang L, Li S, Kotliar D, Zhang W, Ghandi M, Garraway L, Fernandes SM, Livak KJ, Gabriel S, Gnirke A, Lander ES, Brown JR, Neuberg D, Kharchenko PV, Hacohen N, Getz G, Meissner A and Wu CJ. Locally disordered methylation forms the basis of intratumor methylome variation in chronic

lymphocytic leukemia. Cancer Cell 2014, Dec 8; 26(6):813-25. doi: 10.1016/j.ccell.2014.10.012. J.F. helped perform the single-cell analyses.

* These authors contributed equally

Software

- HoneyBADGER - R package for phylogenetic reconstruction and copy number alteration detection at the single cell level from single cell RNA-seq data

- SCDE/PAGODA - R package for single cell differential expression and pathway and gene set over-dispersion analysis

- brainmapr - R package to infer spatial location of neuronal subpopulations within the developing mouse brain by integrating single cell RNA-seq data with in situ hybridization data from the Allen Developing Mouse Brain Atlas

- LIGER - a light-weight R implementation of the Broad Gene Set Enrichment Analysis algorithm

- UBiT2 - user-friendly bioinformatics webtool for analyzing single cell transcriptomic data

Teaching

- **Summer Institute in Biomedical Informatics**   DBMI/HST
  Teaching Assistant   *June 2017 – Aug. 2017*
    - Mentored group of 18 undergraduate summer students.

- **Computer Programming for Future Entrepreneurs**   The Innovation Institute
  Lead Instructor   *Sept. 2016 – June 2017*
    - Designed, wrote, and lead course curriculum for a classroom of 4th to 8th grade students. The year long 2-hour weekly course exposed students to computer programming for the web using HTML, CSS, and Javascript, and apply what they've learned to develop web applications to address social issues in their communities.

- **Summer Institute in Biomedical Informatics**   DBMI/HST
  Teaching Assistant   *June 2016 – Aug. 2016*
    - Mentored group of 20 undergraduate summer students.

- **Computer Programming for Future Scientists and Engineers**   The Innovation Institute
  Lead Instructor   *Sept. 2015 – June 2016*
    - Designed, wrote, and lead course curriculum for a classroom of 4th to 8th grade students. The year long 2-hour weekly course exposed students to logic, syntax, objects, classes, functions, loops, file-parsing and other key elements of programming in Python.Students apply their skills to various projects including correlation analysis on data from Google Trends, conservation analysis on multiple sequence alignments, machine learning with decision trees, and more.

- **Single Cell Workshop 2015**   Harvard Stem Cell Institute
  Teaching Fellow   *Nov. 2015*
    - Organized by Lev Silberstein and Peter Kharchenko
    - Designed, wrote, and lead lesson for Analysis of Heterogeneity and Subpopulations. (course website)

- **Single Cell Workshop 2014**   Harvard Stem Cell Institute
  Teaching Fellow   *Oct. 2014*
    - Organized by Lev Silberstein and Peter Kharchenko
    - Designed and wrote lesson for Continuous Differences: Ordering cells within heterogeneous populations according to major or secondary axes of variation. (course website)

- **Introduction to Optimization 550.361**   Johns Hopkins University
  Teaching Assistant   *Aug. 2012 – Dec. 2012*
    - Taught by Donniell Fishkind

- Led multiple hands-on Matlab sessions and exam review workshops for 100s of students
- Taught weekly sections and held office hours, assisted with grading homework and exams. (section website)

Select Invited Talks and Posters

- **Fan J**. Classifying and characterizing single cells using transcriptional and epigenetic analysis. Minisymposium - After the Data Deluge: Grappling With Transcriptional Complexity in the Brain. Society for Neuroscience 2017. (Talk)

- **Fan J**. CuSTEMized: Encouraging girls to see themselves in STEM. Pass-It-On Award winners panel. Grace Hopper Celebration 2017. (Talk/Panelist)

- **Fan J**. Linking genetic and transcriptional intratumoral heterogeneity at the single cell level. Models, Inference, and Algorithms seminar series. Broad Institute, 2017. (Talk)

- **Fan J**. Bioinformatics for Single Cell Analysis. Division of Immunology Bioinformatics Seminar, 2017 (Talk)

- **Fan J**, Lee H, Lee S, Ryu D, Lee S, Kim SJ, Kim K, Park PJ, Park WY, Kharchenko PV. Linking transcriptional and genetic tumor heterogeneity through allele analysis of single-cell RNA-seq data. Wellcome Genome Campus, Single Cell Genomics Conference, 2016 (Poster)

- **Fan J**. Applying single cell transcriptomics - unraveling the complexity of the developing human brain. Festival of Genomics, Single Cell Genomics, 2016 (Talk)

- **Fan J**. Do art like a science. Do science like an art. TEDxJHU, Instructions Not Included, 2016 (Talk)

- **Fan J**. JHU Young Alumni Leadership Symposium. March 2016 (Talk)

- **Fan J**. Wang L, Brooks AN, Wan Y, Neuberg D, Rassenti K, Ghia E, Kipps T, Brown JR, Li S, Livak KJ, Meyerson MM, Kharchenko PV, Wu CJ Comprehensive Bulk and Single Cell Transcriptomic Characterization of SF3B1 Mutation Reveals its Pleiotropic Effects in Chronic Lymphocytic Leukemia. American Society of Hematology, 57th Annual Meeting and Exhibition, 2015 (Poster), and Biological and Biomedical Sciences Student Retreat 2015 (Talk)

- **Fan J**, Salathia N, Liu R, Kaeser G, Yung Y, Herman J, Kaper F, Fan JB, Zhang K, Chun J, and Kharchenko PV. PAGODA - Pathway and gene set overdispersion analysis characterizes single cell transcriptional heterogeneity. Cold Spring Harbor. Single Cell Analysis Meeting, 2015 (Talk)

- **Fan J**, Lee HO, Lee S, Lee A, Park WY, Park PJ, Kharchenko PV. Hierarchical Bayesian Approach for CNV Detection from Single Cell RNA-seq Data. National Institutes of Health, Single Cell Investigators Meeting, 2015 (Poster), and Harvard Graduate Women in Science and Engineering 10th Year Anniversary Symposium, 2015 (Poster)

- **Fan J**, Salathia N, Liu R, Yung Y, Fan JB, Chun J, Zhang K, Kharchenko PV. Single Cell Differential Expression Identifies Neural Progenitor Subpopulations in the Developing Mouse Brain. National Institutes of Health, Single Cell Investigators Meeting, 2014 (Poster), and Biological and Biomedical Sciences Student Retreat 2014 (Talk)

- **Fan J**, Karchin R. Computational Assessment of the Utility of Limiting Orthologous Sequence Depth in Mutation Impact Prediction Performance. International Congress of Human Genetics/American Society of Human Genetics Conference, 2011 (Poster), the BME Undergraduate Research Day, Johns Hopkins University, 2012 (Poster), and Provost's Undergraduate Research Poster Session, Johns Hopkins University, 2012 (Poster)

- **Fan J**, Sohail M, Sunyaev S. Detecting Synergistic Epistasis in Humans. Harvard-MIT Health Science and Technology and i2b2 Bioinformatics and Integrative Genomics Summer Conference, 2012 (Talk)

Awards and Honors

- Anita Borg Pass-It-On Award Winner, $1,000 USD award (2017)

- BU GWISE Advocate of the Year (2017)

- Regeneron "Dream Proposal" Prize Finalist, $5,000 USD award (2017)

- NSF MRS Outreach Award Recipient, $250 USD award (2016)

- ASH Abstract Achievement Award Recipient, $500 USD award (2015)

- Provost's Undergraduate Research Award Winner (2012)

- Intel Science Talent Search Semi-Finalist, $4000 USD award (2009)

- Siemens Competition in Math, Science and Technology Semi-Finalist, $1000 USD award (2008)

Extracurriculars and Outreach

CuSTEMized - personalized STEM picture storybooks for girls
Founder, Director, Lead Developer   *Jan. 2014 – Present*
  - Ran successful Kickstarter campaign, raising $6,186
  - Co-wrote and illustrated children's books that describe various STEM careers
  - Created an innovative web platform that allows parents to personalize and download on-demand books using their child's name and likeness via avatars
  - Established collaborations with national organizations and schools to provide personalized books for free to under-served classrooms and communities. Over 300 free personalized books provided to date.
  - Over 11,000 personalized storybooks created to date

Harvard Graduate Women in Science and Engineering (HGWISE)
Co-Chair   *Aug. 2013 – Aug. 2015*
  - Spearheaded organization of 10th year anniversary celebration: the WISE Beyond Your Years symposium
  - Organized and directed organization of meetings, talks, career panels, assertiveness and leadership workshops
  - Created and maintained the HGWISE website

Science Club for Girls (SCFG)
2nd Grade Mentor-Scientist   *Aug. 2014 – May 2015*
  - Taught weekly after-school lessons for Body Maps and Light and Sound curriculums

Women in Science at Harvard-Radcliffe (WISHR)
Mentor for Undergraduates at Harvard College   *Aug. 2013 – Aug. 2014*