Vivek Gopalakrishnan

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I am an incoming PhD student in the Harvard-MIT Program in Health Science and Technology. My past research has focused on the development of machine learning methods to analyze multi-subject neuroimaging data (advised by Dr. Joshua T. Vogelstein and Dr. Carey E. Priebe). Most recently, I developed statistical graph theory algorithms to perform biomarker discovery in network-valued maps of the brain. I also led a Design Team of undergraduate biomedical engineers (advised by Dr. Elizabeth Logsdon and Dr. Rani Hasan). We built a dynamic fusion image guidance system for minimally invasive heart surgery.

▬▬▬ Education

8/21 – present
(Incoming)

Massachusetts Institute of Technology and Harvard Medical School, Cambridge, MA.
Doctor of Philosophy (Ph.D.) in Medical Engineering and Medical Physics.
- **Advisors:** Professor Rahul Deo (in rotations).
- **Concentration Area:** Computer Science.

8/20 – 5/21

Johns Hopkins University, Baltimore, MD.
Master of Science and Engineering (M.S.E.) in Biomedical Engineering. GPA: 3.77/4.
- **Advisors:** Professors Joshua T. Vogelstein (primary) and Carey E. Priebe (secondary).
- **Concentration Area:** Biomedical Data Science.
- **Thesis:** *Multiscale Statistical Hypothesis Testing for k-Sample Graph Inference*.

8/17 – 5/21

Johns Hopkins University, Baltimore, MD.
Bachelor of Science (B.S.) in Biomedical Engineering. GPA: 3.77/4.
- **Advisor:** Professor René Vidal.
- **Concentration Area:** Biomedical Data Science.

▬▬▬ Research and Engineering Experience

1/20 – 5/21

Design Team Leader, *Dept. of Biomedical Engineering*, Johns Hopkins University.
- Team leader and project manager for a team of eight undergraduate engineers.
- Developing a dynamic fusion image guidance system for minimally invasive heart surgery.
- **Skills used:** *Computer vision, image registration, cardiology, Python, and Git.*

9/18 – 5/21

Undergraduate Research Assistant, *Neurodata Lab*, Johns Hopkins University.
- Developed novel machine learning methods for analyzing populations of graph-valued objects [3, 1].
- Discovered neuro-connectively similar subtypes of autism using joint embeddings of multi-network connectomes [4, 7].
- **Skills used:** *Graph theory, statistics, machine learning, Python, and Git.*

Summer 2018

Summer Student Researcher, *Ghebremichael Lab*, Ragon Institute of MGH, MIT and Harvard.
- Developed predictive models of disease progression and immune recovery in HIV-positive children with TB co-infection [2].
- Identified biomarkers for antiretroviral toxicity by applying machine learning methods to HIV-patient data [5].
- **Skills used:** *Survival analysis, ROC models, R, and Git.*

12/17 – 5/18

Design Team Member, *Dept. of Biomedical Engineering*, Johns Hopkins University.
- Designed and implemented a clinical machine learning algorithm to predict the onset of lung failure in pediatric patients.
- **Skills used:** *Representation learning, sparse dictionary learning, Python, and Git.*

6/17 – 7/17 **Summer Researcher**, *Fondazione Bruno Kessler*, Trento, Italy.
- ○ Implemented a deep learning algorithm to quantitatively assess crop damage from images taken by farmers.
- ○ **Skills used:** *Computer vision, Keras, Python, and Git.*

6/16 – 6/17 **High School Researcher**, *Tufts University BioSeq Program*, Tufts University.
- ○ Used next-generation sequencing (NGS) to generate a novel human oral microbiome data set.
- ○ Analyzed sequence data using dimensionality reduction and hidden Markov models to identify microbial biomarkers of oral health.
- ○ Presented at the 2017 Intel International Science and Engineering Fair, Los Angeles, CA.
- ○ **Skills used:** *DNA library construction, next-generation sequencing, dimensionality reduction, hidden Markov models, and R.*

Publications and Preprints

[1] Jaewon Chung, Eric Bridgeford, Jesus Arroyo, Benjamin D. Pedigo, Ali Saad-Eldin, **Vivek Gopalakrishnan**, Liang Xiang, Carey E Priebe, and Joshua T Vogelstein. "Statistical Connectomics". *Annual Review of Statistics and Its Application* (Mar. 2021). DOI: https://doi.org/10.1146/annurev-statistics-042720-023234.

[2] **Vivek Gopalakrishnan**, Eliezer Bose, Usha Nair, Yuwei Cheng, and Musie Ghebremichael. "Pre-HAART CD4+ T-Lymphocytes as Biomarkers of Post-HAART Immune Recovery in HIV-Infected Children with or without TB Co-Infection". *BMC Infectious Diseases* (Oct. 2020). DOI: 10.1186/s12879-020-05458-w.

[3] **Vivek Gopalakrishnan**, Jaewon Chung, Eric Bridgeford, Benjamin D. Pedigo, Jesús Arroyo, Lucy Upchurch, G. Allan Johnson, Nian Wang, Youngser Park, Carey E. Priebe, and Joshua T. Vogelstein. "Multiscale Comparative Connectomics". *arXiv:2011.14990* (Nov. 2020). arXiv: 2011.14990.

[4] Nian Wang, Robert J Anderson, David G Ashbrook, **Vivek Gopalakrishnan**, Youngser Park, Carey E Priebe, Yi Qi, Rick Laoprasert, Joshua T Vogelstein, Robert W Williams, and G Allan Johnson. "Variability and Heritability of Mouse Brain Structure: Microscopic MRI Atlases and Connectomes for Diverse Strains". *NeuroImage* (Aug. 2020). DOI: 10.1016/j.neuroimage.2020.117274.

[5] Jong Soo Lee, Elijah Paintsil, **Vivek Gopalakrishnan**, and Musie Ghebremichael. "A Comparison of Machine Learning Techniques for Classification of HIV Patients with Antiretroviral Therapy-Induced Mitochondrial Toxicity from Those Without Mitochondrial Toxicity". *BMC Medical Research Methodology* (Nov. 2019). DOI: 10.1186/s12874-019-0848-z.

Conference Presentations

[6] **Vivek Gopalakrishnan** and Joshua T Vogelstein. "Statistical Methods for Multiscale Comparative Connectomics". *NeuroMatch*. Oct. 2020. URL: https://www.neuromatch.io/abstract?submission_id=recARY71P6SjXY3xK.

[7] **Vivek Gopalakrishnan** and Joshua T Vogelstein. "Towards Discovering Heterogeneity in Autism via Multi-Network Connectomics". *Biomedical Engineering Society (BMES)*. Philadelphia, PA, Oct. 2019.

Skills

Programming	Python, R, C++, git, LaTeX
DevOps	GitHub, AWS, Docker, CircleCI
APIs	NumPy, Pandas, scikit-learn, PyTorch, Matplotlib, Seaborn
Bioinformatics	Microbiome and B cell repertoire analysis

Wet Lab   Microfabrication, 3-D tissue culture, NGS library construction

Teaching

Spring '21   **Head TA** – **NeuroData Design II**, *EN.BME.438/638*, Johns Hopkins University.

Fall '20   **Head TA** – **NeuroData Design I**, *EN.BME.437/637*, Johns Hopkins University.

Fall '20   **TA** – **Linear Algebra**, *AS.MATH.201*, Johns Hopkins University.

Fall '20   **TA** – **Computational Cardiology Lab**, *EN.BME.487*, Johns Hopkins University.

Fall '18   **Head PILOT Leader**, *Dept. of Academic Support*, Johns Hopkins University.
to Spring '20   ○ Led group tutoring sessions (≈ 10 students/group), and wrote weekly problem sets and lectures.
   ○ Led weekly meetings to train junior PILOT leaders in mathematics and pedagogy.

Fellowships and Awards

2020   **Provost's Undergraduate Research Award**, *Office of Undergraduate Research*, Johns Hopkins University.

2019   **INBT Research Award**, *Institute for NanoBioTechnology*, Johns Hopkins University.

2019   **Joseph C. Pistritto Research Fellowship**, *Dept. of Computer Science*, Johns Hopkins University.

2018   **AWS Cloud Credits for Research Grant**, *Dept. of Computer Science*, Johns Hopkins University.

2017   **Second Place Winner**, *Intel International Science and Engineering Fair (ISEF)*, Category: Microbiology.

2017   **Internship Award**, *Intel ISEF Special Award*, Fondazione Bruno Kessler.

2017   **Semi-Finalist**, *Regeneron Science Talent Search*, Microbiology.

2017   **Second Place Winner**, *Massachusetts State Science & Engineering Fair*.

2016   **Second Place Winner**, *Massachusetts State Science & Engineering Fair*.