Vivek Gopalakrishnan

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I am a combined BS/MSE student in the Department of Biomedical Engineering at Johns Hopkins University. My research focuses on developing machine learning methods to analyze multi-subject neuroimaging data (advised by Dr. Joshua T. Vogelstein and Dr. Carey E. Priebe). Currently, I am building a Random Forest (RF)-based computer vision algorithm to perform robust and interpretable brain tumor segmentation. I also lead a Design Team of undergraduate biomedical engineers (advised by Dr. Elizabeth Logsdon and Dr. Rani Hasan). We are building a dynamic fusion image guidance system for minimally invasive heart surgery.

Education

08/20 – 05/21   **M.S.E Biomedical Engineering**, Johns Hopkins University.

GPA 4.0. Focus in *Biomedical Data Science*. Advised by Professor Joshua T. Vogelstein.
- **Computational Coursework**: Bioinformatics, Deep Learning & Discrete Optimization
- **Math Coursework**: NeuroData Design, Matrix Analysis, Causal Inference

08/17 – 05/21   **B.S. Biomedical Engineering**, Johns Hopkins University.

GPA *3.77*. Advised by Professors Carey E. Priebe and Joshua T. Vogelstein.
- **Computational Coursework**: Probabilistic Models of the Visual Cortex, Biomedical Data Science, Computational Cardiology, Build an Imager
- **Math Coursework**: Multivariate Calculus, Linear Algebra, Differential Equations, Probability, Statistics, Honors Real Analysis

Research and Engineering Experience

01/20 – now   **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, tensorflow, Python, and Git.*

09/18 – now   **Undergraduate Research Assistant**, *Neurodata Lab*, Johns Hopkins University.
- Developing Random Forest-based computer vision algorithm for brain tumor segmentation.
- Developed novel machine learning methods for analyzing populations of graph-valued objects [5, 1].
- Discovered neuro-connectively similar subtypes of autism using joint embeddings of multi-network connectomes [3, 7].
- **Skills used:** *Graph theory, statistical learning theory, Python, Cython, and Git.*

05/18 – 08/18   **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 [4].
- **Skills used:** *Survival analysis, ROC models, R, and Git.*

12/17 – 05/18   **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.*

06/17 – 07/17   **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.*

06/16 – 06/17   **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

[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 (In Press)* (Oct. 2020). DOI: 10.31219/osf.io/ek4n3.

[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] 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.

[4] 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.

Submitted (Preprints)

[5] **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.

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, Keras, TensorFlow, PyTorch, Matplotlib, Seaborn, Plotly
Bioinformatics	Microbiome and B cell repertoire analysis

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

Teaching

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

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

Fall '20   **TA – NeuroData Design**, *EN.BME.437/637*, 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*.