Sourabh Palande

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# Summary

# I’m a curious and versatile data scientist, applied mathematician, and researcher in machine learning methods and applications. I focus on developing methods that leverage topology and geometry in machine learning, statistical analysis, and visualization. I have worked on interdisciplinary projects, collaborating with neuroscientists and biologists and published research papers in leading journals and conferences. I have experience working with imaging (MRI, fMRI, X-Ray CT, RGB) and network-structured (brain networks, \*omics) data. I enjoy solving complex problems and I’m passionate about advancing science and making a real-world impact with research.

# Education

# PhD in Computing (Image Analysis) | University of Utah | Salt Lake City, UT | Aug 2015 - Jul 2020.

* Thesis: “Utilizing Topological Structures of Data for Machine Learning.”
* Advisor: Dr. Bei Wang-Phillips.

# MSc in Applied Mathematics | University of Manchester | Manchester, UK | Sep 2013 - Oct 2014.

* Dissertation: “Analysis of the Source Trajectory in Cone Beam Micro CT.”
* Advisor: Prof. Bill Lionheart.

# BSc in Mathematics | University of Pune | Pune, India | Jul 2004 - Oct 2007.

* Specialization in **Computational Mathematics,** minored in Physics and Statistics.

# Research Experience

# Postdoctoral Research Associate | CMSE, Michigan State University | East Lansing, MI | Oct 2020 - Present.

# Lead interdisciplinary collaborative projects with a team of mathematicians, computer scientists and biologists.

* Developed, implemented image analysis pipeline to extract shape information from plant 3D XRay CT scans.
* Developed machine learning model to extract leaf vasculature from 2D RGB images.
* Developed exploratory visual analytics tools for plant morphology and cross-species gene expression data.
* Helped design and publish a novel interactive book introducing python programming to biology students:

Plants & Python **(**<https://plantsandpython.github.io/PlantsAndPython>).

# Graduate Research Assistant | SCI Institute, University of Utah | Salt Lake City, UT | May 2016 - Jul 2020.

* Collaborated with neuroscientists, applying advanced data science techniques in autism research.
* Implemented MRI and fMRI processing pipelines, performed comparative analysis of different pipelines.
* Developed and implemented novel machine learning and data analysis methods for brain networks.
* Generalized spectral graph learning algorithms to simplicial complexes, hypergraphs.
* Developed novel metrics to evaluate and visualize local, node-level uncertainty in graph coarsening.
* Developed a framework to compare and perform computations on ensembles of trees structures
* Helped design a visualization tool for DNN interpretability: TopoAct (https://tdavislab.github.io/TopoAct)

# Awards and Honors

# American Mathematical Society (AMS) | 2022-2023 | Models and Methods for (Hyper) Network Science.

* Invited to participate in Mathematical Research Communities (MRC):

<https://www.ams.org/programs/research-communities/2022MRC-HyperNet>

* Received travel awards to attend conferences and funding for continued collaborative research.

# Simons Institute for Theory of Computing | Fall 2018 | Foundations of Data Science.

* Invited to participate as a visiting graduate researcher in the Fall semester program on mathematical foundations of data science: https://simons.berkeley.edu/programs/datascience2018

# XRadia (Zeiss) and University of Manchester | Summer 2014 | Dissertation Award.

* Awarded GBP 3000 in funding to carry out dissertation research with industrial collaborators.

# Teaching

# Guest Instructor | HRT 841: Plants & Python | Michigan State University | Fall 2020.

* A graduate level course introducing biology students to data analysis and computational biology.
* Trained students to apply topological data analysis techniques in plant biology; guided course projects.

# Teaching Assistant | CS 6170: Computational Topology | University of Utah | Spring 2017.

* A graduate level course. 50% teaching and 100% grading responsibilities. Guided student projects.
* Trained students in topological data analysis theory, algorithms and applications to real-world data.

# Teaching Assistant | CS 6210: Advanced Scientific Computing | University of Utah | Fall 2016.

* Graduate level course. Handled 50% teaching and full grading responsibilities.
* Trained students to implement numerical algorithms and to perform performance and error analysis.

# Other Work Experience

# Quantitative Analyst | Algoanalytics Financial Consultancy | Pune, India | Jun 2011 - Jun 2013.

# Developed price prediction models for securities, commodities using machine learning and time series analysis.

* Designed and implemented automated, high frequency trading strategies.

# Equity Trader and Portfolio Manager | Self Employed | Pune, India | Jan 2009 - Jun 2011.

* Analyzed financial statements and historical market trends to identify trading and investing opportunities.
* Managed a diversified portfolio of securities, delivering 3X returns in 30 months.

# Invited Talks

# Leveraging topological structures in data analysis, machine learning, and visualization, Seattle Children’s Research Institute, Mar 2023.

# The topological shape of gene expression across the evolution of flowering plants, SIAM MDS 2022 Minisymposium: Topological Data Analysis with Mapper, Sep 2022.

# TDA + ML” Utilizing topological structures of data for machine learning, MSU TDA Seminar, Oct 2020.

# Publications

**Preprints**

* **Sourabh Palande**, Joshua Kaste, Miles Roberts, Kenia Segura Aba, Carly Claucherty et al. "The topological shape of gene expression across the evolution of flowering plants." *bioRxiv* (2022).
* Sarah Percival, **Sourabh Palande**, Beronda Montgomery, et al., “Using mapper graphs to reveal morphological relationships in passiﬂora leaves,” *Authorea Preprints authorea:essoar.10508822.1*, 2022.
* Li, Mingzhe, **Sourabh Palande**, Lin Yan, and Bei Wang. "Sketching merge trees for scientific data visualization." *arXiv preprint arXiv:2101.03196* (2021).

**Journal Articles**

* Robert VanBuren, Alejandra Rougon-Cardoso, Erik J. Amézquita, Evelia L. Coss-Navarrete, Aarón Espinosa-Jaime, et al., “Plants & Python: A series of lessons in coding, plant biology, computation, and bioinformatics,” The Plant Cell, vol. 34, no. 7, e1–e1, Jul. 2022
* Archit Rathore, Nithin Chalapathi, **Sourabh Palande**, and Bei Wang, “Topoact: Visually exploring the shape of activations in deep learning,” Computer Graphics Forum, vol. 40, no. 1, pp. 382–397, 2021.
* Braxton Osting, **Sourabh Palande**, and Bei Wang, “Spectral sparsification of simplicial complexes for clustering and label propagation.” *Journal of Computational Geometry (JoCG)*, vol. 11, no. 1, pp. 176–211, 2020,

\*Authors listed alphabetically.

* **Sourabh Palande**, Vipin Jose, Brandon Zielinski, Jeffrey Anderson, P. Thomas Fletcher, and Bei Wang, “Revisiting Abnormalities In Brain Network Architecture Underlying Autism Using Topology-Inspired Statistical Inference.” *Brain Connectivity*, vol. 9, no. 1, pp. 13–21, 2019,

PMID: 30543119. Eprint: h[ttps://doi.org/10.1089/brain.2018.0604](https://doi.org/10.1089/brain.2018.0604)

**Conference Proceedings**

* Fangfei Lan, **Sourabh Palande**, Michael Young, and Bei Wang, “Uncertainty visualization for graph coarsening,” in *2022 IEEE International Conference on Big Data (Big Data)*, 2022, pp. 2922–2931.
* Sarah Percival, Erik J. Amezquita, **Sourabh Palande**, Aman Husbands, Arjun Krishnan, Beronda Montgomery, Elizabeth Munch, and Daniel Chitwood. "Using Mapper to Reveal Morphological Relationships in Passiflora Leaves." In *2022 Spring Central Sectional Meeting*. AMS, 2022.
* Archit Rathore, **Sourabh Palande**, Jeffrey Anderson, Brandon Zielinski, P. Thomas Fletcher, and Bei Wang, “Autism Classification Using Topological Features And Deep Learning: A Cautionary Tale.” in *Medical Image Computing and Computer Assisted Intervention – MICCAI 2019, Springer International Publishing,* Oct. 2019.
* Keri Anderson, Jeffrey Anderson, **Sourabh Palande**, and Bei Wang, “Topological Data Analysis Of Functional MRI Connectivity In Time And Space Domains.” in *Connectomics in NeuroImaging (CNI) at Medical Image Computing and Computed Assisted Intervention (MICCAI), Springer International Publishing*, Sep. 2018.

**\* Best Paper Award.**

* **Sourabh Palande**, Vipin Jose, Brandon Zielinski, Jeffrey Anderson, P. Thomas Fletcher, and Bei Wang, “Revisiting Abnormalities In Brain Network Architecture Underlying Autism Using Topology-Inspired Statistical Inference.” in *Lecture notes in Computer Science (including subseries Lecture notes in Artificial Intelligence and Lecture notes in Bioinformatics),* Vol 10511 LNCS, Springer Cham, pp 98-107, 2017.
* Eleanor Wong, **Sourabh Palande**, Bei Wang, Brandon Zielinski, Jeffrey Anderson, and P. Thomas Fletcher, “Kernel Partial Least Squares Regression For Relating Functional Brain Network Topology To Clinical Measures Of Behavior.” in *2016 IEEE 13th International Symposium on Biomedical Imaging (ISBI)*, Apr. 2016.

# Service

# Organizer, MSU Topological Data Analysis Seminar, Fall 2021 - Present.

# Reviewer, Biomedical Signal Processing and Control (BSPC), Summer 2022 - Present.

# Reviewer, Medical Image Computing and Computer Aided Intervention (MICCAI), 2023.

# Reviewer, Topology, Algebra, and Geometry in Pattern Recognition with Applications (TAG-PRA), 2023.

# Sub-Reviewer, Symposium on Computational Geometry (SoCG), 2023.

# Sub-Reviewer, Mathematical Foundations of Computer Science (MFCS), 2022.

# Sub-Reviewer, European Symposium on Algorithms (ESA), 2021.