Pushpak Pati

Researcher in Machine Learning & Computer Vision for Computational Biology
Flühgasse 32, 8008 Zürich, Switzerland | Phone: +41779114646
pushpak.nitrkl@gmail.com | Homepage | Github | Linkedin | Google scholar

Summary

6+ years of experience in developing machine learning and computer vision algorithms for computational biology . Main focus on **graph representation learning** for modeling tissue microenvironment for various biomedical tasks across multiple cancer types. Also investigating **generative modeling** and **continual learning** for pathology, radiology, and retinal images. Released **2** popular graph-analytics software for accelerating biomedical research (**17k+** downloads). **20+** top-tier journal and conference publications. **4** patents (2 granted, 2 filed). **10+** student supervision.

Work Experience

Postdoctoral Researcher
IBM Research - Zürich
Feb. 2022 - Present
Zürich, Switzerland

- Composite staining optimization in immunohistochemistry: **Leading** a team of 5 researchers from IBM
- Concept disentanglement learning for biomarker discovery: **Leading** a team of 7 researchers from IBM
- Quantum computing for drug discovery: **Co-leading** a global IBM Research flagship project involving a team of 20 researchers
- Continual unsupervised domain adaptation: **Contributor**
- **Collaborations**: (computational researchers) UK Science and Technology Facilities Council, Stony Brook University (clinicians and experimental researchers) University of Bern, Imperial College London, Royal Brompton, Cleveland Clinic

Doctoral Researcher
IBM Research - Zürich
Jan. 2018 - Dec. 2021
Zürich, Switzerland

- Graph representation learning in computational pathology
- **Collaborations**: (computational researchers) ETH, EPFL, ICAR CNR. (clinicians and experimental researchers) Harvard Medical School, Mayo Clinic, University Hospital of Zürich, University of Bern, CHUV Lausanne, University Hospital of Paris, National Research Council of Italy
- 10+ invited talks in top-tier universities, university hospitals, and industries. 5 workshop organization/chairing.

Software Development Engineer
Microsoft
Jul. 2013 - Aug. 2015
Hyderabad, India

- Key Information Service - a RESTful service for Microsoft's product activation database
- Partner Quote - an enterprise quote-to-order solution for volume licensing (40% revenue generating system for Microsoft)

Statistical Machine Learning Research Intern
Indian Statistical Institute
May 2012 - Dec. 2012
Kolkata, India

- Genetic algorithm for Fuzzy rule base optimization with expert knowledge integration

Education

Ph.D. in Electrical Engineering & Information Technology
ETH Zürich
May 2018 - Jan. 2022
Zürich, Switzerland

- **Advisors**: Prof. Orçun Göksel, Computer Vision Lab, ETH Zürich
  Dr. Maria Gabrani, IBM Research Zürich
- **Thesis**: **Deep learning of entity-guided representations in digital pathology** [Thesis]
  Spatial modeling of tissue microenvironments via biology inspired graphs and learning with Graph Neural Networks for scalable and interpretable cancer diagnosis
- **Awards**: ETH Medal for Outstanding Doctoral theses (Nominated)
  2 Technical achievement awards at IBM
  3 Best paper awards at prominent workshops
- **Publications**: 17 top-tier. 16 published (6 journals, 6 conferences, and 4 workshops) and 1 journal under review
- **Releases**: HistoCartography library for graph-analytics in digital pathology. BRIGHT breast pathology dataset.

M.Sc. in Electrical Engineering & Information Technology
ETH Zürich
Sep. 2015 - Sep. 2017
Zürich, Switzerland

- Focus on AI, ML, CV, and Medical imaging. **GPA**: 5.4/6.0
- **Thesis**: **Automatic quality assessment and standardization of immunostaining**
  Stain quality metric for immuno-staining quantification; and data-driven disease-aware staining process parameter optimization

B.Tech. in Electronics & Instrumentation Engineering
National Institute of Technology
Jul. 2009 - May 2013
Rourkela, India

- **Thesis**: **Self-tuning optimized fuzzy logic controller on Xilinx Vertex-5**
  Self-tuning and rule-optimized multi-input and multi-output PID Controller on Xilinx FPGA using Fuzzy logic and Genetic algorithm
- **Awards**: Department rank 2/90. **GPA**: 9.6/10.0
  All India CoreEL Digilent Design Contest, ranked 5/20 finalists

Honors & Awards

- **BRIDGE Proof of Concept Grant (Finalist),** SNSF & Innosuisse 2022
- **ETH Medal for Outstanding Doctoral Thesis (Nominated),** ETH Zürich 2022
- **Outstanding Technical Achievement Award,** IBM Research - Europe & Africa 2021
- **Best Software Paper Award,** MICCAI, Computational Pathology Workshop 2021
- **Research Division Accomplishment Award,** IBM Research - Europe 2020
- **Best Paper Award,** MICCAI, Graphs in Biomedical Image Analysis Workshop 2020
- **Best Paper Award,** ICML, Computational Biology Workshop 2020

Patents

- Processing Multimodal Images of Tissue for Medical Evaluation — US Patent App. 17/346,195
  P. Pati, G. Jaume, K. Thandiackal, A. Foncubierta-Rodríguez, M. Gabrani
- Interpretation of Whole-slide Images in Digital Pathology — US Patent App. 16/953,377
  P. Pati, G. Jaume, A. Foncubierta-Rodríguez, M. Gabrani
- Biomarker Quantification in a Tissue Sample — US Patent App. 15/924,745
  G. Kaigala, A. Fomitcheva-Khartchenko, A. Kashyap, M. Gabrani, **P. Pati**
- Tissue Staining Quality Determination — US Patent App. 15/699,204
  N. Arar, **P. Pati**, M. Gabrani, G. Kaigala, A. Kashyap, A. Fomitcheva-Khartchenko

Open-Source Software

BiomedSciAI [CODE] Jul. 2022 - Present

Collection of tools to accelerate scientific discovery for population-scale data (*e.g.,*EHRs), subcellullar-scale data (*e.g.,*spatially resolved omics), and a combination of various modalities. **Role**: Contributed to the development of multimodal toolkit, that integrates pathology, radiology and clinical reports, and building APIs to interface FuseMedML and HistoCartography.

ATHENA [CODE] Apr. 2022 - Present

Python library to visualize, process and analyse spatial heterogeneity from spatial omics data, *e.g.,*spatial proteomic and transcriptomic, including IMC, MIBI, mIHC/IF, seqFISH, MERFISH, Visium. 5,000+ downloads since release. **Role**: Contributed to the development of concept-guided learning and heterogeneity quantification modules, and extending applications to spatial single-cell proteomics.

HistoCartography [CODE] Apr. 2021 - Present

Python library to facilitate graph analytics in digital pathology. Plug-and-play modules to perform histology image pre-processing, entity-graph building and learning, model interpretability and explainability. 12,000+ downloads since release. **Role**: Led the end-to-end conceptualization, development, and deployment.

Technical Skills

Machine learning:	PyTorch, Tensorflow, Keras, DGL, Pytorch Geometric, scikit-learn, scikit-image, numpy, pandas, OpenCV
Programming languages:	Python, C++, C#
DevOps/MLOps:	Github, MLflow, TensorBoard, LSF, Travis CI, Docker
Others:	Adobe Illustrator, LaTex, Trello

Academic Services (selected)

Workshop Organization/ Chairing

- Machine Learning for Medical Imaging (ML4MI), ACML 2022
- BReast tumor Image classification on Gigapixel HisTopathological image (BRIGHT), IEEE ISBI 2022
- Explainable Multimodal AI in Cancer Patient Care, American Medical Informatics Association 2021
- Building Interpretable AI for Digital Pathology, Applied Machine Learning Days, EPFL 2021
- Artificial Intelligence for Digital Pathology, ICPR 2021

Reviewer

- CVPR, ECCV, MICCAI, IJCAI, ICPR, Nature, Medical Image Analysis, IEEE Trans. on Medical Imaging, 2019 - Present

Selected Publications

*denotes equal contribution | †under review manuscript venue | Full publication list at Google scholar

Journals

- Multi-scale Feature Alignment for Continual Learning of Unlabeled Domains — †IEEE Trans. Med. Imag. 2023
  K. Thandiackal*, L. Piccinelli*, **P. Pati**, O. Goksel
- Matching Single Cells across Modalities with Contrastive Learning and Optimal Transport [CODE] — Briefings in Bioinformatics 2023
  F. Gossi, **P. Pati**, A. Martinelli, M. Rapsomaniki
- Weakly Supervised Joint Whole-Slide Segmentation and Classification in Prostate Cancer — †Medical Image Analysis 2022
  P. Pati*, G. Jaume*, B. Bozorgtabar, M. Gabrani, O. Goksel
- Generative Appearance Replay for Continual Unsupervised Domain Adaptation — †Medical Image Analysis 2022
  B. Chen*, K. Thandiackal*, **P. Pati**, O. Goksel
- Hierarchical Graph Representations in Digital Pathology [CODE] — Medical Image Analysis 2021
  P. Pati*, G. Jaume*, A. Foncubierta-Rodríguez, F. Feroce, A. Anniciello, G. Scognamiglio, N. Brancati, M. Fiche, E. Dubruc, D. Riccio, M. Di Bonito, G. De Pietro, G. Botti, J. Thiran, M. Frucci, O. Goksel, M. Gabrani
- Reducing Annotation Effort in Digital Pathology: A Co-Representation Learning Framework — Medical Image Analysis 2021
  P. Pati, A. Foncubierta-Rodríguez, O. Goksel, M. Gabrani
- High-Quality Immunohistochemical Stains through Assay Parameter Optimization — IEEE Trans. Biomed. Eng. 2019
  N. Arar*, **P. Pati***, A. Kashyap, A. Fomitcheva-Khartchenko, O. Goksel, G. Kaigala, M. Gabrani
- Quantitative Microimmunohistochemistry for The Grading of Immunostains on Tumour Tissues — Nature Biomed. Engg. 2019
  A. Kashyap*, A. Fomitcheva-Khartchenko*, **P. Pati**, M. Gabrani, P. Schraml, G. Kaigala

Conferences & Workshops

- ChromFormer: A Transformer-based Model for 3D Genome Structure Prediction [CODE] — NeurIPS-W 2022
  H. Valeyre*, **P. Pati***, F. Gossi, V. Somnath, A. Martinelli, M. Rapsomaniki
- Differentiable Zooming for Multiple Instance Learning on Whole-Slide Image [CODE] — ECCV 2022
  K. Thandiackal*, B. Chen*, **P. Pati**, G. Jaume, D. Williamson, M. Gabrani, O. Goksel
- Learning Whole-Slide Segmentation from Inexact and Incomplete Labels using Tissue Graphs [CODE] — MICCAI 2021
  V. Anklin*, **P. Pati***, G. Jaume*, B. Bozorgtabar, A. Foncubierta, J. Thiran, M. Sibony, M. Gabrani, O. Goksel
- HistoCartography: A Toolkit for Graph Analytics in Digital Pathology [CODE] — MICCAI-W Best Software Paper, 2021
  G. Jaume*, **P. Pati***, V. Anklin, A. Rodríguez, M. Gabrani
- Quantifying Explainers of Graph Neural Networks in Computational Pathology [CODE] — CVPR 2021
  G. Jaume*, **P. Pati***, B. Bozorgtabar, A. Rodriguez, F. Feroce, A. Anniciello, T. Rau, J. Thiran, M. Gabrani, O. Goksel
- HACT-Net: Hierarchical Cell-to-Tissue Graph Neural Network for Histology Image Classification [CODE] — MICCAI-W Best Paper Award, 2020
  P. Pati*, G. Jaume*, L. Fernandes, A. Rodríguez, F. Feroce, A. Anniciello, G. Scognamiglio, N. Brancati, D. Riccio, M. Di Bonito, G. De Pietro, G. Botti, O. Goksel, J. Thiran, M. Frucci, M. Gabrani
- Towards Explainable Graph Representations in Digital Pathology [CODE] — ICML-W Best Paper Award, 2020
  G. Jaume*, **P. Pati***, A. Foncubierta-Rodríguez, F. Feroce, G. Scognamiglio, A. Anniciello, J. Thiran, O. Goksel, M. Gabrani
- Computational Immunohistochemistry: Recipes for Standardization of Immunostaining — MICCAI 2017
  N. Arar, **P. Pati**, A. Kashyap, A. Fomitcheva-Khartchenko, O. Goksel, G. Kaigala, M. Gabrani