Dr.-Ing. Debdas Paul

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Marital Status: Married to a Software Engineer (Java developer), no kids
More about me: Homepage, Linkedin, Scholar, Github, Erdös Number, XING

SUMMARY

I am an **engineer** and a **computational scientist** committed to **lifelong learning**, and I thrive in **interdisciplinary, cross-functional environments**. I began my career as a **computer science engineer**, but my fascination with the complexity of biological systems ultimately led me to transition into **theoretical systems biology**. At the moment, I am into bringing **data-driven insights** using **machine/deep learning models** from **complex high-dimensional** (in terms of features) biological data.

EDUCATION

Stuttgart, Germany — **University of Stuttgart** — **2014 - 2019**

- **Dr.-Ing.** (**PhD in Engineering**) with ***Magna Cum Laude***.
- **Advisor: Prof. Dr. rer. nat. Nicole E Radde, Institute of Stochastics and Applications**
- **Technical Skills**: MATLAB, Numerical simulation, ODE based modeling, Stochastic simulation

Finland and Stockholm, Sweden — **Aalto University and KTH** — **2012 - 2014**

- **MS** and **MSc. (Tech.)** in **Computational Systems Biology** with a ***Distinction***
- **Technical Skills**: MATLAB, **Python**
- **Selected subjects**: Machine learning, Applied and numerical mathematics

Kolkata, India — **Jadavpur University** — **2009 - 2011**

- **Master of Engineering** in **Computer Science & Engineering**
- **Technical skills**: **Python**
- **Selected subjects**: Advanced algorithm design, Machine learning, Information theory, NLP, Pattern recognition

Kolkata, India — **West Bengal University of Technology** — **2005 - 2009**

- **Bachelor of Technology** in **Computer Science & Engineering**
- **Technical skills**: C, Java
- **Selected subjects**: Algorithm design, Theoretical Computer Science, Operating systems, Engineering mathematics, Control systems, Engineering physics, Database management systems.

EMPLOYMENTS

Postdoc. Data scientist/Project leader — **Leibniz Institute on Aging, Jena, Germany** — **April 2023 - present**

- **Challenge**: robust and accurate age-prediction model from high-dimensional (in terms of features, **~10-15k**), noisy biological data **while preventing confounding effects (variables** that distort the relationship between an exposure and an outcome).
- **Redeveloped** an **adversarial learning** strategy using a deep neural network with a **custom training module** that adjusts for **confounder effects** in the **latent space**. The approach is **interpretable through feature attribution** and is **data-modality agnostic**, allowing any dataset with matching numerical features to be used.
- **Implemented** hyperparameter optimization module using **Optuna** and integrated feature selection strategy using **Keras** and **Tensorflow**. Our feature-selection approach employs **L1-regularization with trainable continuous weights** (as opposed to the **non-differentiable discrete L1**), and transitions to **Bernoulli-based feature masking** during inference.
- **As the main applicant and project leader**, I worked closely with a three member team to secure the Go-Bio initial grant of ~100K EUR for 2024-25 from the Federal Ministry for Research, Technology and Aeronautics, Germany. This funding supports FtO analysis, market research, and optimizing and productionizing the

aforementioned deep learning model towards realizing the discovery platform [media coverage]. This grant equips me with **entrepreneurial experience** that I can carry forward into future roles in industry.

- The work is **selected for a spotlight presentation and poster** at the EurIPS Causality for Impact workshop, 2025 in Copenhagen.

Postdoctoral scientist (machine learning) — **University Hospital, Tübingen, Germany** — **June 2020 - August, 2022**

- **Challenge:** extracting reliable, predictive patterns from high-dimensional (in terms of features), noisy biological data using scalable and robust machine learning methods.
- **Led** an international, cross-disciplinary project and drove the machine learning strategy for large-scale biomedical data integration.
- **Extended** an **in-house weakly supervised representation learning framework** using a **convolutional neural network (implemented using Python and Tensorflow)** to extract high-value representations from **complex, high-dimensional** mass-cytometry data (a 2D matrix of samples X biomarkers). The framework provides a coarse level labelling helping to identify **rare cell types (data points with very low frequencies).**
- **Applied** the model to uncover previously unknown predictive biomarkers, demonstrating the framework's ability to detect subtle, early-stage patterns in noisy real-world datasets.
- The findings were disseminated in *Frontiers in Immunology*.

Postdoctoral scientist — **Max Planck Inst. for Biophysical Chemistry, Germany** — **Feb 2019 - May, 2020**

- **Challenge**: Accurately quantify and analyze how the immune system fails to display cancer-related mutated peptides
- **Designed** and implemented **Bayesian statistical models** using **MCMC methods** to enhance peptide quantification accuracy.
- **Developed** an R-based tool for analyzing proteasome-mediated peptide degradation dynamics.
- **Achieved** improved peptide quantification, yielding more precise insights into proteasome function.
- The findings were disseminated in *Frontiers in Immunology*.

Doctoral researcher — **University of Stuttgart, Germany** — **Nov 2014 - April, 2019**

- **Challenge**: How biological systems maintains robust signal propagation under noise (say for a **time-variant input**)?.
- **Applied** systems theory and stochastic simulations to uncover key mechanisms that sustain signal propagation and resilience in biological systems.
- **Leveraged systems theory** and performed **stochastic simulations** to analyze **signal propagation dynamics**.
- Focused on the role of retroactive effects (bi-directional signal propagation) in maintaining the resilience of phosphorylation cascades.
- **Revealed** the critical role of retroactive effects in sustaining resilience within a phosphorylation cascade, contributing to a deeper understanding of biological signal propagation.
- **Disseminated** the findings in a book chapter*, a conference proceeding*,#, and in the *Journal of Theoretical Biology**,#. *=first author, # = corresponding author

PROJECTS AS A VISTING RESEARCHER AND AS PART OF INDEPENDENT COLLABORATION

Boston, MA, USA — **Dept. of Systems Biology, Harvard Medical School** — **07/2017 - 10/2017**

- **Developed** a rule-based model using the Kappa language framework to study gene regulation.
- **Created** a succinct and adaptable graphical representation of molecular interactions.
- **Provided** valuable insights into the dynamics of gene regulation and molecular processes.
- **Advisor:** Prof. Jeremy Gunawardena

Uppsala, Sweden **Division of Scientific computing, Uppsala University** **01/2014 - 06/2014**

- **Conducted** numerical analysis to evaluate an optimized pre-conditioning scheme.
- **Demonstrated** that the scheme significantly **reduced computation steps** for exact Chemical Master Equation (CME) calculations by **approximately 80%** while maintaining comparable convergence characteristics despite the reduction in computation steps.
- Results were disseminated in the form of masters thesis in theoretical biological physics
- **Advisor:** **Prof. Stefan Engblom**

Koper, Slovenia **Dept. of Mathematics, University of Primorska** **02/2011 - 03/2011**

- **Implemented** eigenvector-based algorithms to identify large bipartite sub-graphs.
- **Utilized** sign patterns of eigenvectors to enhance the accuracy of the algorithm.
- **Achieved** results that are consistent with Erdős' bound for the graph.
- **Published** the findings in *Discrete Applied Mathematics*[*,#]. [TALK], *=first author, # = corresponding author
- **Collaborator:** **Prof. Dragan Stevanovic**

AWARDS

- Go-Bio initial from the **Federal Ministry for Research, Technology and Aeronautics**, Germany ~100K EUR for 2024-25
- **European Union's Erasemus Mundus Fellowship**, equivalent to Fullbright, totaling EUR 48K for 2012-14.
- **Bilateral Mobility Grant** from the Government of the Republic of Slovenia in 2011.

KEY PROGRAMMING AND TECHNICAL SKILLS

- **Languages**: **Python** [**for machine learning, frequently used**], R [**for data visualization**], MATLAB [**used as doctoral student for ODE based modeling and stochastic simulation**]
- **Machine learning/Deep learning libraries**: Scikit-learn, TensorFlow [**related to current position at the Leibniz Institute and the postdoc. position at the University Hospital Tübingen**]
- **Machine learning models**: Regression based **(K-NN, Linear/Logistic regressor, ElasticNet),** Tree-based models (**XGBoost, LightGBM**) - **for benchmarking purpose against neural network-based models.**
- **Data manipulation/visualization:** Pandas, NumPy, Matplotlib, Seaborn [**related to current position at the Leibniz Institute**]
- **Version control/container technologies**: Git [**frequently use for my projects**], Docker [**seldom use it**]

PRIVATE CONTINUOUS LEARNING

Whenever I have time, I try to stay updated on technological advancements relevant to the software industry. (clickable):

- Oracle Cloud Infrastructure 2025 Certified AI Foundations Associate (Oct, 2025) - BADGE
- End-to-end machine learning operations (MLOps) with Azure Machine Learning [July, 2023]
- Microsoft Azure Fundamentals: Describe cloud concepts [July, 2023]
- Deploying Scalable Machine Learning for Data Science [Jan, 2022]
- Succeeding in DevOps [Jan, 2022]

LANGUAGES I SPEAK

- English (Fluent) - German (B1, Goethe) - Bengali (Native)

HOBBIES

- **Reading** - I am an avid reader, fiction and non-fiction both. I prefer a physical copy rather a digital one.
- **Badminton** - I play sometimes
- **Hiking** - whenever I find a good weather.