Sourasekhar Banerjee, Ph.D.

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RESEARCH OBJECTIVES

My research objective is to develop reliable and adaptive **federated learning** methods for distributed environments where data are **heterogeneous, privacy-sensitive, and continuously evolving**. I am particularly interested in addressing challenges related to **personalization, continual adaptation, privacy, robustness, and explainability** while maintaining strong theoretical foundations and practical efficiency. Through this work, I aim to connect advances in federated optimization and distributed AI with real-world applications such as **IoT security, continuous sensing, cognitive health, image privacy, and cross-institutional learning**, where centralized data collection is often impractical or undesirable.

EDUCATION

Ph.D. in Computing Science, Umeå University, Sweden 2020 – 2024
Thesis: "Advancing Federated Learning: Algorithms and Use-Cases."
Supervisors: Assoc. Prof. Monowar Bhuyan; Prof. Erik Elmroth

M.Tech. in Computer Science & Engineering, University of Calcutta, India 2016 – 2018
First Class; 82.83%
Thesis: "A Framework Towards Generalized Mid-term Energy Forecasting Model for Industrial Sector in Smart Grid." *Supervisor:* Prof. Nabendu Chaki

M.Sc. in Computer Science, University of Calcutta, India 2014 – 2016
First Class; 75.54%

Thesis: "A Design towards Reduced Message Complexity using Symmetric Algorithm for Process Synchronization." *Supervisor:* Prof. Nabendu Chaki

B.Sc. in Computer Science (Hons.), St. Xavier's College, India 2011 – 2014
First Class; 71%

Higher Secondary (WBCHSE) , Mahes Sri Ramkrishna Ashram Vidyalaya 2009 – 2011
Passed; 81% (Best of Five)

Secondary (WBBSE) , Mahes Sri Ramkrishna Ashram Vidyalaya 2009
Passed; 82.75%

PROFESSIONAL EXPERIENCE

Application Expert *Oct 2026 – Present*
National Academic Infrastructure for Supercomputing in Sweden (NAISS)
Swedish AI Factory, Linköping University, Sweden

- Develop and deliver training on advanced artificial intelligence methods and applications for researchers, small and medium-sized enterprises (SMEs), and start-ups across Sweden.
- Provide specialist technical consultancy to SMEs on the development and application of AI methods to address their specific needs.

RESEARCH EXPERIENCE

Postdoctoral Researcher *Uppsala University, Sweden*
Department of Information Technology Oct 2024 – September, 2026

- Developed a domain continual learning-based intrusion detection system for RPL-IoT attack domains, evaluating catastrophic forgetting under distributional shift across heterogeneous IoT traffic.
- Designing a **domain-specific diffusion replay** for continual intrusion detection in distributed RPL-IoT networks. (Submitted)
- Investigated the use of the **MOMENT foundation model** for multi-class attack identification in RPL-based IoT networks, demonstrating competitive attack detection and effective differentiation among Blackhole, DIS Flooding, Worst Parent, and Local Repair attacks.
- Developed an LSTM-based intrusion detection system for RPL-based IoT networks that enhances attack detection by integrating TX/RX radio features with routing-layer features, achieving up to ~4% improvement

in F1-score across DIS-Flooding, Local Repair, and Worst Parent attacks.
- Developed FedLIME, a clustered federated learning method that groups clients by **LIME attribution (Explainability)** divergence instead of weight similarity. (Ongoing)

Research Intern *A*STAR IHPC, Singapore*
Institute of High Performance Computing Apr 2024 – Jun 2024

- Designed a **Federated Image Privacy Advisor** using personalized FL daisy-chaining, achieving a 30% improvement in privacy scoring accuracy over global FL baselines. Conducted multi-modal (text + image) FL experiments; compared privacy risks under global and personalized FL settings across multiple attack scenarios.

Doctoral Researcher *Umeå University, Sweden*
Department of Computing Science Jun 2020 – Sep 2024

- Authored and defended a PhD thesis covering personalized FL algorithms, feature selection, straggler mitigation, event-memorability and privacy risk prediction.
- Designed scalable personalized FL algorithms addressing statistical heterogeneity (non-IID distributions) with rigorous convergence analysis.
- Developed privacy risk prediction models quantifying per-client leakage as a function of model architecture and aggregation strategy.
- Built personalized FL models for **cognitive science** (event memorability prediction).

Research Fellow *IIT Patna, India*
Department of Computer Science & Engineering Aug 2018 – Jun 2020

- Designed an edge-deployable computer vision model for banned object detection in real-time.
- Delivered an embedded ML solution optimised for resource-constrained edge environments, resulting in a granted Indian patent.

PUBLICATIONS

Journal Articles

[1] **Banerjee, S.**, Bhuyan, D., Elmroth, E., and Bhuyan, M. (2024). "Cost-Efficient Feature Selection for Horizontal Federated Learning." *IEEE Transactions on Artificial Intelligence*, vol. 5, no. 12, pp. 6551–6565.

Conference Papers

[2] **Banerjee, S.**, Bergqvist, D., Toor, S., Rohner, C., and Johnsson, A. (2026). "Quantifying Catastrophic Forgetting in IoT Intrusion Detection Systems." In *Proc. IEEE International Conference on Communications (ICC)*.

[3] **Banerjee, S.**, Subramaniam, V., Roy, D., Subbaraju, V., and Bhuyan, M. (2026). "Personalized Image Privacy Advisors via Federated Daisy-Chaining." In *Proc. IEEE/CVF Winter Conference on Applications of Computer Vision (WACV)*, pp. 2808–2817.

[4] **Banerjee, S.**, Roy, D., Subbaraju, V., and Bhuyan, M. (2025). "Predicting Event Memorability Using Personalized Federated Learning." In *Proc. IEEE/CVF Winter Conference on Applications of Computer Vision (WACV)*, pp. 1556–1565.

[5] Dadras, A., **Banerjee, S.**, Prakhya, K., and Yurtsever, A. (2024). "Federated Frank-Wolfe Algorithm." In *Proc. Joint European Conference on Machine Learning and Knowledge Discovery in Databases (ECML-PKDD)*, pp. 58–75. Springer.

[6] **Banerjee, S.**, Dadras, A., Yurtsever, A., and Bhuyan, M. (2024). "Personalized Multi-tier Federated Learning." In *Proc. International Conference on Neural Information Processing (ICONIP)*, pp. 192–207. Springer.

[7] **Banerjee, S.**, Patel, Y. S., Kumar, P., and Bhuyan, M. (2023). "Towards Post-disaster Damage Assessment using Deep Transfer Learning and GAN-based Data Augmentation." In *Proc. 24th International Conference on Distributed Computing and Networking (ICDCN)*, pp. 372–377. ACM.

[8] **Banerjee, S.**, Vu, X.-S., and Bhuyan, M. (2022). "Optimized and Adaptive Federated Learning for Straggler-Resilient Device Selection." In *Proc. International Joint Conference on Neural Networks (IJCNN)*, pp. 1–9. IEEE.

[9] **Banerjee, S.**, Elmroth, E., and Bhuyan, M. (2021). "Fed-FiS: A Novel Information-Theoretic Federated Feature Selection for Learning Stability." In *Proc. International Conference on Neural Information Processing (ICONIP)*, pp. 480–487. Springer.

[10] **Banerjee, S.**, Misra, R., Prasad, M., Elmroth, E., and Bhuyan, M. (2020). "Multi-diseases Classification from Chest X-ray: A Federated Deep Learning Approach." In *Proc. Australasian Joint Conference on Artificial Intelligence (AI 2020)*, pp. 3–15. Springer.

[11] Patel, Y. S., **Banerjee, S.**, Misra, R., and Das, S. K. (2020). "Low-Latency Energy-Efficient Cyber-Physical Disaster System Using Edge Deep Learning." In *Proc. 21st International Conference on Distributed Computing and Networking (ICDCN)*, pp. 34:1–34:6. ACM.

[12] Chakraborty, M., **Banerjee, S.**, and Chaki, N. (2020). "A Framework Towards Generalized Mid-term Energy Forecasting Model for Industrial Sector in Smart Grid." In *Proc. International Conference on Distributed Computing and Internet Technology (ICDCIT)*, pp. 296–310. Springer.

[13] **Banerjee, S.**, Mukherjee, P., Kanrar, S., and Chaki, N. (2018). A novel symmetric algorithm for process synchronization in distributed systems. In Proc. Algorithms and Applications (ALAP) , pp. 51-66. Singapore.

Patent

[14] Shekhar, H., **Banerjee, S.**, Misra, R., and Patel, Y. S. (2024). "System and Method for Detection of Banned Objects from Images in Real-time using Intelligence at the Edge." Indian Patent No. 550543, Application No. 202031006618, Filed. Feb 15, 2020. Granted. Sep 19, 2024

Book Chapters

[15] **Banerjee, S.**, Ghosh, S., and Mishra, B. K. (2021). Application of deep learning for energy management in smart grid. In Deep Learning in Data Analytics: Recent Techniques, Practices and Applications (pp. 221-239). Springer.

Workshop

[16] Lunderbye, E., **Banerjee, S.**, Rohner, C., and Johnsson, A. (2026). "Towards Intrusion Detection Systems for RPL-based IoT Networks using Foundation Models." Accepted and presented in the Swedish National Computer Networking Workshop (SNCNW), arXiv preprint arXiv:2606.03530.

[17] Sun, Y., Johnsson, A., and **Banerjee, S.** (2026). "Rethinking IoT Intrusion Detection: Augmenting Routing Metrics with Radio Features." Accepted and presented in the Swedish National Computer Networking Workshop (SNCNW), arXiv preprint arXiv:2606.07282.

PEDAGOGICAL TRAINING

Academic Teacher Training Course — *Uppsala University, Sweden*
Unit for Academic Teaching and Learning — Autumn 2025

- Completed a university-level teacher training course covering curriculum design, constructive alignment, formative and summative assessment, inclusive teaching strategies, research-based teaching, and digital learning environments.
- **Project:** "Responsible Integration of LLMs in Higher Education"

TEACHING EXPERIENCE

Teacher — *Uppsala University, Sweden*
Department of Information Technology — Period III: Jan–Mar 2025, Jan–Mar 2026

- *Information Technology and Energy Storage.* [course link]
- Delivered lectures, tutorials, and assignments covering theoretical foundations of machine learning and data-driven applications in battery management systems.

Teaching Assistant — *Umeå University, Sweden*
Department of Computing Science — Period III: Jan–Mar 2022, Jan–Mar 2023

- *Operating Systems* (2022, 2023).
- Delivered tutorials and lab sessions reinforcing core OS concepts including process management, memory allocation, scheduling, and kernel programming.

STUDENT SUPERVISION

Master's Thesis Supervision

- "Machine Learning for Cybersecurity in Internet of Things Networks." — Yichang Sun [2026] *(Completed)*

Bachelor's Thesis Supervision

- "Benchmarking Federated Learning Algorithms for Intrusion Detection in RPL-IoT networks" — Robin Forslund [2026] *(Completed)*

- "An Investigation into Intrusion Detection System Generalisation Against Novel Attacks" — Max Dahlgren [2026] *(Completed)*
- "Intrusion Detection System Generalisation in IoT Blackhole Attacks" — Oskar Nylin [2025] *(Completed)*
- "Assessing the Generalizability and Scalability of an IoT Intrusion Detection System against DIS-Flooding Attack Variants" — Hans-Eskil Ytterfelt Martinsson [2025] *(Completed)*

AWARDS, COMPETITIVE GRANTS & FUNDING

- **Research Internship Grant** (110,000 SEK) — A*STAR IHPC, Singapore. Awarded by the Wallenberg AI, Autonomous Systems and Software Program (WASP), 2024.
- **Research Internship Grant** (140,000 SEK) — Imperial College London, UK. Awarded by the Wallenberg AI, Autonomous Systems and Software Program (WASP), 2023.
- **Travel Grant** ($500 USD) — IEEE World Congress on Computational Intelligence (WCCI), 2022.
- Awarded **GATE** Fellowship for M.Tech education in 2016
- Qualified **UGC-NET Assistant Professor** in 2018
- Qualified **Joint Entrance Screening Test (JEST)** in 2018

PROFESSIONAL SERVICE

Peer Review

- *Conferences:* NeurIPS, ICML, AAAI, ICLR, AISTATS, ICONIP, IJCNN, ACSS.
- *Journals:* IEEE TAI, IEEE TCSS, Sensors, MDPI.

Invited Talks

- Industry & Research: Ericsson Research Sweden (2025); NTU Singapore (2023); A*STAR IHPC Singapore(2023, 2024); Scaleout AB Uppsala (2025)
- Faculty Development Programs: SRM University (2025, 2026); NIT Delhi (2025); NIT Warangal (2025); IIIT Gwalior (2025)

TECHNICAL SKILLS

- **Federated Learning Frameworks:** FEDn, Flower, and NVIDIA FLARE
- **ML / Data Science:** Federated Learning, Continual Learning, Personalised ML, Statistical Optimisation, Feature Selection, Predictive Modelling, Time-Series Modelling, Multi-modal Analysis, Anomaly Detection, Privacy-Preserving AI
- **Deep Learning:** CNN, LSTM, GAN, VAE, Transformers, Autoencoder, Diffusion Models
- **GenAI / LLM:** RAG, vector database, Agentic AI, Fine-tuning, LORA/PEFT
- **Data Science Stack:** Python, PyTorch, scikit-learn, pandas, NumPy, Matplotlib, Seaborn, SQL
- **MLOps / DevOps:** Docker, Kubernetes, Git, GCP, Azure
- **Programming Languages:** Python, JAX, C/C++, Java

REFERENCES

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