Li Ju

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Summary

Final-year Ph.D. candidate in Scientific Computing specializing in federated learning, uncertainty quantification, and multi-modal language models. Holds a track record of publications in top-tier venues, including NeurIPS. Seeking a role of Research Scientist, Applied Scientist, or Machine Learning Engineer.

Education

Ph.D. in Scientific Computing 09.2021 – 06.2026 (Expected)
Uppsala University *Uppsala, Sweden*

M.Sc. in Computational Science 09.2019 – 08.2021
Uppsala University *Uppsala, Sweden*

M.Sc. in Chemometrics, with Honors 09.2016 – 06.2019
University of Science and Technology of China *Hefei, China*

B.Sc. in Chemistry 09.2012 – 06.2016
University of Science and Technology of China *Hefei, China*

Work Experience

Doctoral researcher 09.2021 – Present
Scientific Machine Learning Laboratory *Uppsala, Sweden*

- Developed methods for modeling aleatoric and epistemic uncertainty in multi-modal models using probabilistic and generative approaches (e.g., hyperspheric probabilistic modeling, Riemannian Flow Matching), outperforming state-of-the-art baselines.
- Designed and implemented novel algorithms for fair federated learning and uncertainty quantification in large-scale vision-language models, leading to multiple publications.
- Contributed to collaborative research of various topics, including attack/defense mechanisms in distributed ML, hierarchical information management systems, and simulation-based inference.
- Instructed graduate courses in *Data Engineering* and *Applied Cloud Computing* and supervised four M.Sc. projects.

Master thesis student 02.2021 – 08.2021
Integrative Scalable Computing Laboratory *Uppsala, Sweden*

- Designed and implemented a proactive Kubernetes autoscaler using predictive modeling, reducing average workload response time by 15% in heterogeneous edge computing environments.

Junior data scientist (Part-time) 06.2020 – 03.2021
Scaleout Systems AB *Uppsala, Sweden*

- Integrated PyTorch support into FEDn, a production-grade open-source federated learning framework, enhancing its core functionality and user adoption.
- Developed proof-of-concept applications in computer vision to demonstrate framework capabilities to potential clients.

Skills & Tools

Modeling: Uncertainty quantification, generative modeling, multi-modal language models, federated learning, probabilistic modeling, self-supervised learning, Bayesian inference.

Frameworks: PyTorch, JAX, pthread, OpenMP, MPI, CUDA, Apache Pulsar.

Cloud & DevOps: Docker, Apptainer, Kubernetes, OpenStack.

Languages: Python, C/C++, Haskell, Erlang, Lisp/Racket.

Main Project Experience

Accelerating fair federated learning

- Analyzed the suboptimal convergence rates of first-order methods in existing federated learning formulations. Reformulated fairness-aware FL as a dynamic multi-objective optimization problem to achieve provably faster convergence while upholding fairness constraints.
- Proposed `AdaFedAdam`, an algorithm with adaptive hyperparameter tuning and normalized updates, providing theoretical guarantees for accelerated convergence and reduced fairness bias.
- Empirically validated the method's Pareto optimality and robustness across standard FL benchmarks under various data and system heterogeneity scenarios.

Aleatoric uncertainty quantification for vision language models

- Investigated the limitations of post-hoc uncertainty quantification methods for pre-trained vision-language models.
- Proposed and empirically validated a hypothesis on the structural asymmetry of uncertainty between vision and language modalities.
- Developed a novel framework to model aleatoric uncertainty in unit hyperspherical space, systematically evaluated against other state-of-the-art methods.
- Demonstrated enhanced model reliability on downstream tasks, including zero-shot classification and image retrieval, by integrating quantified uncertainty.

Epistemic uncertainty quantification for vision language models

- Investigated the limitations of existing uncertainty quantification methods for pre-trained vision-language models and identified the need for improved epistemic uncertainty modeling.
- Proposed a generative framework using Riemannian flow matching to explicitly model epistemic uncertainty in VLMs.
- Validated the approach through extensive experiments on standard VLM benchmark datasets and demonstrated significant improvements in model robustness and reliability, particularly for out-of-distribution detection.

Selected Publications

- **Ju, L.**, Andersson, M., Fredriksson, S., Glöckner, E., Hellander, A., Vats, E., & Singh, P. (2025). Exploiting the Asymmetric Uncertainty Structure of Pre-trained VLMs on the Unit Hypersphere. Advances in Neural Information Processing Systems 2025.
- **Ju, L.**, Zhang, T., Toor, S., & Hellander, A. (2024). Accelerating Fair Federated Learning: Adaptive Federated Adam. IEEE Transactions on Machine Learning in Communications and Networking.
- **Ju, L.**, Hellander, A., & Spjuth, O. (2024). Federated Learning for Predicting Compound Mechanism of Action Based on Image-data From Cell Painting. Artificial Intelligence in the Life Sciences.
- **Ju, L.**, Singh, P., & Toor, S. (2021). Proactive Autoscaling for Edge Computing Systems with Kubernetes. Proceedings of the 14th IEEE/ACM International Conference on Utility and Cloud Computing Companion.
- **Ju, L.**, Nautiyal, M., Vats, E., & Singh, P. Epistemic Uncertainty Quantification for Pre-trained VLMs via Riemannian Flow Matching (manuscript in preparation).

Awards & Leadership

- **1st Place in Europe, 2nd Place Globally** in Huawei Sweden Hackathon (2025): Developed a neural operator for SVD approximation, competing against ∼500 teams from across the world.
- **2nd Place** in Huawei Sweden Hackathon (2024): Solved a wireless localization problem using channel charting, competing against over 30 European teams.
- **President** of Society for Industrial and Applied Mathematics (SIAM), Uppsala University Chapter (2024 – 2025). Organized seminars and workshops on numerical analysis and scientific computing.