




Debora Caldarola

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Ph.D. Student in Federated Learning

Personal Information

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Research Interests

Artificial Intelligence (AI) has the potential to revolutionize numerous domains, but concerns regarding **fairness** and **responsibility** have emerged as critical considerations. Developing AI algorithms that are fair, accountable, and socially responsible is imperative for mitigating biases and ensuring equitable outcomes. In my current research, I focus on leveraging **Federated Learning** (FL) as a powerful paradigm to reach such goals. FL aims to learn a global model from disparate users' data, while respecting the privacy regulations in force. Looking at realistic scenarios, my main efforts aim to

- Learn models providing fair predictions to the entire data distribution, e.g., not biased towards some less represented demographic groups, while protecting the users' privacy.
- Broaden the horizons of applicability of FL to real-life vision tasks, such as autonomous driving, or image geo-localization, while introducing realistic constraints, e.g., the absence of labeled data.

Education

- September - December 2023 **Visiting Student Researcher**, *Stanford University*, Stanford, CA, USA.
Project title: *Federated learning and fairness*
Advisor: Prof. Sanmi Koyejo
- 2020 - Now **Ph.D. in Computer Engineering**, *ELLIS VANDAL Lab*, Politecnico di Torino.
Thesis: *Federated Learning across Domains*
Advisor: Prof. Barbara Caputo
Co-advisor: PhD Marco Ciccone
- 2018 - 2020 **Master's Degree in Computer Engineering**, *Data Science*, Politecnico di Torino, Grade: 110/110.
Master's Thesis: *Towards Real World Federated Learning*
Supervisors: Prof. B. Caputo (Politecnico di Torino), Prof. F. Galasso (Università degli Studi di Roma "La Sapienza"), Dr. M. Mancini (Eberhard Karls University of Tübingen)
- 2015 - 2018 **Bachelor's Degree in Computer Engineering**, Politecnico di Torino, Grade: 110/110.
- 2015 - 2018 **Young Talents Project**, Politecnico di Torino.
Educational path aimed at 200 Bachelor students ranking in the top 5%.
- 2010 - 2015 **Scientific High School Diploma**, "Marco Vitruvio Pollione" Scientific High School, Grade: 100/100.

Professional Experience

- 2020 - Now **Organizer**.
 - **WiCV (Women in Computer Vision) Workshop at ICCV 2023**. Committee member.
 - **I-RIM 2021** (Italian Institute of Robotics and Intelligent Machines). Volunteer.

2021 - Now **Reviewer.**

Conferences

- International Conference on Learning Representations (ICLR) 2022, 2023, 2024
- Neural Information Processing Systems (NeurIPS) 2023
- International Conference on Machine Learning (ICML) 2023
- Unifying Representations in Neural Models - NeurIPS Workshop 2023
- Conference on Computer Vision and Pattern Recognition (CVPR) 2021, 2022, 2023
- European Conference on Computer Vision (ECCV) 2022
- IEEE/CVF Winter Conference on Applications of Computer Vision (WACV) 2023
- European Conference on Machine Learning (ECML) 2023
- International Conference on Robotics and Automation (ICRA) 2023, 2024
- International Conference on Pattern Recognition (ICPR) 2022

Journals

- IEEE Transactions on Distributed and Parallel Systems
- IEEE Internet of Things Journal
- IEEE Robotics and Automation Letters
- Neural Networks Elsevier

2018 - 2019 **Intern.**

- **Student Researcher in ERC project.** *Applied Electromagnetics* research group, Politecnico di Torino. Supervised by Prof. Francesco P. Andriulli.
- **SEI Explorer** (School of Entrepreneurship & Innovation). Internship aimed at discovering the bases of business and start-up creation.

Teaching

2021 - Now **Invited speaker.**

- *Towards Real-world Federated Learning.* Stanford University, CA.
- *Real-world Challenges in Federated Learning.* Continual Learning Reading Group with Isabelle Guyon (Director Research Scientist, Google Brain), Eleni Triantafillou (Research Scientist, Google Brain), Joaquin Vanschoren (Eindhoven University of Technology, OpenML founder)
- *Introduction to Federated Learning,* Fall School PhD Industry 4.0. Torino, IT.
- *Introduction to Federated Learning,* Machine Learning Operations Summer School. Copenhagen, DK.

2021 - Now **Teaching assistant, Politecnico di Torino.**

- Advanced Machine Learning, M.Sc course. A.y.s. 2022/2023, 2021/2022.
- Machine Learning and Deep Learning, M.Sc course. A.y.s. 2022/2023, 2021/2022/, 2020/2021.
- Data Analysis and Artificial Intelligence, M.Sc course. A.y.s. 2022/2023, 2021/2022.
- Informatics, B.Sc course. A.y. 2021/2022.
- Computer Architectures, B.Sc course. A.y. 2018/2019. Laboratory assistant.

2021 - Now **Master's Theses Supervisor, Politecnico di Torino.**

- *Computation-efficient Sharpness-aware Minimizers in Federated Learning.* P. Cagnasso. *On-going.*
- *Federated Vision Transformers.* L. Marcellino. *On-going.*
- *Federated Visual Place Recognition.* M. Dutto.
- *Speeding Up Convergence while Preserving Privacy in Heterogeneous Federated Learning.* A. Rizzardi.
- *Sequential to Parallel Federated Learning with Semantic-Aware Client Groupings.* A. Silvi.
- *On the Challenges of Class Imbalance in Federated Learning for Semantic Segmentation.* E. Fani.
- *On the Challenges of Federated Learning in Semantic Segmentation across Domains.* L. Fantauzzo.

Attended Schools and Programs

September 2022 **M2L Summer School, Mediterranean Machine Learning Summer School,** Milan, IT. Organized by Google DeepMind.

July 2021 **DeepLearn 2021 Summer, IRDTA 4th International School on Deep Learning,** Las Palmas de Gran Canaria, ES.

February - June 2021 **Innovation 4 Change (I4C),** Politecnico di Torino. Leading impact innovation program in Italy. Promoted by Collège des Ingénieurs Italia, CERN Ideasquare and Politecnico di Torino. Collaboration with Arduino's CMO and CEO.

Awards

2023 **Awarded The Foundation Blanceflor Scholarship.**

The Foundation Blanceflor aims to promote international exchange within scientific research and education. The scholarship supports the visiting period at Stanford University.

2018 **Induction in the *Mu Nu Chapter, IEEE Eta Kappa Nu.***

Membership in Eta Kappa Nu - the honor society of *IEEE* (Institute of Electrical and Electronic Engineers): permanent designation for those who have distinguished themselves as students or professionals in the fields of interest of *IEEE*.

2014 **Awarded the Micron Technology Scholarship.**

Scholarship awarded for a three-month exchange period in Canada, promoted by Intercultura.

Extra Professional Experience

2006 - Now **Scout, A.G.E.S.C.I..**

I have been a scout since the age of ten, first as a participant and then as a leader. I strongly believe in the values of this association and in its educational offer.

2018 - 2020 **President, *Mu Nu Chapter of IEEE Eta Kappa Nu*, Politecnico di Torino.**

Eta Kappa Nu aims to recognise excellence among peers, encourage individual eminence in education and meritorious work in professional practice, placing the emphasis not only on scholastic merits but also on the character and attitude of its members. I had the honor of being part of this Association as Head of Logistics and Fundraising first and then as President.

Publications

Preprints (Under Review)

Silvi, A.*, Rizzardi, A.*, **Caldarola, D.**, Ciccone, M., & Caputo, B. (2023). *Accelerating Federated Learning via Sequential Training of Grouped Heterogeneous Clients.*

Dutto, M., Fanì, E., Trivigno, G., **Caldarola, D.**, Berton, G. M., Masone, C. (2023). *Federated Visual Place Recognition.*

2023

Caldarola, D., Caputo, B., & Ciccone, M. (2023). *Window-based Model Averaging Improves Generalization in Heterogeneous Federated Learning.* Proceedings of the *IEEE/CVF International Conference on Computer Vision Workshop (ICCVW23)*.

Shenaj, D.*, Fanì, E.*, Toldo, M., **Caldarola, D.**, Tavera, A., Michieli, U., Ciccone, M., Zanuttigh, P., & Caputo, B. (2022). *Learning Across Domains and Devices: Style-Driven Source-Free Domain Adaptation in Clustered Federated Learning.* Proceedings of the *IEEE Winter Conference on Applications of Computer Vision (WACV23)*.

2022

Caldarola, D., Caputo, B., & Ciccone, M. (2022). *Improving Generalization in Federated Learning by Seeking Flat Minima.* Proceedings of the *European Conference on Computer Vision (ECCV22)*.

Fantauzzo, L.*, Fanì, E.*, **Caldarola, D.**, Tavera, A., Cermelli, F., Ciccone, M., & Caputo, B. (2022). *FedDrive: Generalizing Federated Learning to Semantic Segmentation in Autonomous Driving.* In *Proceedings of the 2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS22)*.

Zaccone, R.*, Rizzardi, A.*, **Caldarola, D.**, Ciccone, M., & Caputo, B. (2022). *Speeding Up Heterogeneous Federated Learning with Sequentially Trained Superclients.* In *Proceedings of the 26th International Conference on Pattern Recognition (ICPR22)*.

2021

Caldarola, D., Mancini, M., Galasso, F., Ciccone, M., Rodolà, E., & Caputo, B. (2021). *Cluster-driven Graph Federated Learning over Multiple Domains.* In *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshop (CVPRW21)* (pp. 2749-2758).

■ Languages and Certificates

Italian (mother tongue), English (C1, *First Certificate in English (FCE) Grade A*), French (scholastic level), German (A1.1), Russian (A1.1).

■ Key Machine Learning Hard Skills

JAX, PyTorch, NumPy, Pandas, Sklearn

Python, JAVA, C/C++

I authorize the processing of my personal data pursuant to Legislative Decree 101/2018 and Article 13 of the GDPR (EU Regulation 2016/679).