

Andrea Cossu

Curriculum Vitae

Computer Science Department
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Personal Statement

I am a post-doc researcher at University of Pisa. My research focuses on Continual Learning, with applications to pre-trained models, Recurrent Neural Networks and sequential data processing.

Research Positions

- 01/05/2023 - **Research Fellow**, *Computer Science Department, University of Pisa*, EU European Innovation Council (EIC) Pathfinder EMERGE project, Grant No. 101070918 (€2.8M, 4 years)
Continual learning for dynamic data and environments.
- 12/12/2022 - **Research Intern**, *Google Brain, Brain Applied Research Team*, Mountain View, California, Dr. Abhijit Ogale
03/03/2023
Few-Shot Personalization with Vision-Language Transformers
- 01/02/2022 - **Visiting researcher**, *KU Leuven*, ESAT department, PSI group, Prof. Tinne Tuytelaars
30/04/2022
Continual Learning with Pre-Trained models and Transformers for Natural Language Processing and Computer Vision

Education

- 2019–2023 **PhD in Data Science**, *Scuola Normale Superiore and University of Pisa*, Italy
November, 1, 2019, – July, 17, 2023
Towards Real-World Data Streams for Deep Continual Learning. The thesis is publicly available at this URL: <https://hdl.handle.net/11384/133982>
- 2017–2019 **Master Degree in Computer Science - AI curriculum**, *University of Pisa*, Italy
October, 15, 2017 – October, 4, 2019
Thesis on continual learning with recurrent neural networks
- 2014–2017 **Bachelor Degree in Computer Science**, *University of Pisa*, Italy
October, 15 2014 – October, 4, 2017
Thesis on novelty detection with Echo State Networks

Affiliations

- 2023–2024 **Research Fellow**, *University of Pisa*
Research Contract on “Continual Learning for Dynamic Environments and Data”.
- 2019–2023 **PhD Student**, *Scuola Normale Superiore and University of Pisa*
- 2021–present **Board Member and Treasurer**, *ContinualAI*, non-profit organization
ContinualAI is the world's largest organization on continual learning, gathering together more than 1000 researchers and enthusiasts.
- 2021–present **Member**, *Pervasive AI (PAI) Lab*, University of Pisa and CNR
- 2019–present **Member**, *Computational Intelligence and Machine Learning (CIML) group*, University of Pisa

Awards

- 2021 **Best library award**, *CLVision workshop at CVPR*, Avalanche: an End-to-End library for Continual learning
- 2022 **Avalanche enters PyTorch ecosystem**

Supervision

- 2023 **Alessandro Trenta**, *Master Degree in Mathematics*, Scuola Normale Superiore, University of Pisa, Solving Conformal Field Theories with Reinforcement Learning
Co-supervised with Pietro Ferrero and Davide Bacciu
- 2022 **Daniele Gabrielli**, *Bachelor Degree in Computer Science*, University of Pisa, (Italian) Piattaforma di Valutazione Continua per Machine Learning
Co-supervised with Vincenzo Lomonaco
- 2021 **Mattia Sangermano**, *Master Degree in Computer Science*, University of Pisa, Sample condensation in Online Continual Learning
Co-supervised with Vincenzo Lomonaco, Davide Bacciu, Antonio Carta
- 2021 **Gabriele Merlin**, *Master Degree in Computer Science*, University of Pisa, Replay-based Approaches for Continual Learning
Co-supervised with Vincenzo Lomonaco, Davide Bacciu, Antonio Carta
- 2020 **Andrea Rosasco**, *Master Degree in Computer Science*, University of Pisa, Distilled Replay: mitigating forgetting through dataset distillation
Co-supervised with Davide Bacciu and Antonio Carta
- 2020 **Newsha Ozgoli**, *Master Degree in Computer Science*, University of Pisa, Evaluation of catastrophic forgetting in Echo State Networks
Co-supervised with Davide Bacciu and Claudio Gallicchio

Teaching activities

- 20/04/2022 - **Teacher (20 hours)**, *Deep Learning laboratory*, Master in Big Data, University of Pisa
10/05/2022 Practical laboratories based on Keras framework. Topics covered: feedforward neural networks, convolutional neural networks for computer vision, recurrent neural networks for time series and sequences, generative models like Generative Adversarial Networks. I also designed the final project together with Prof. Davide Bacciu and graded half of the submissions.
- 22/11/2021 - **Teaching assistant (16 hours)**, *Continual Learning: On Machines that can Learn Continually*, University of Pisa, ContinualAI, First world's open-access course on Continual Learning: <https://course.continualai.org/>
20/12/2021 I revised the material and slides, updated the course website with additional material and references and interacted with the students attending remotely by answering their questions during the lectures. I gave a 30 minutes talk on my research activity on continual sequence learning.
- 19/04/2021 - **Teacher (20 hours)**, *Deep Learning laboratory*, Master in Big Data, University of Pisa
17/05/2021 Practical laboratories based on Keras framework. Topics covered: feedforward neural networks, convolutional neural networks for computer vision, recurrent neural networks for time series and sequences, generative models like Generative Adversarial Networks. I also designed the final project together with Prof. Davide Bacciu and graded half of the submissions.
- 19/08/2021 **Contributor (10 minutes module)**, *Continual Learning nanolecture*, Neuromatch academy
I created the slides and practical exercises (jupyter notebooks) for the continual learning evaluation module within Neuromatch school.
- 01/10/2020 - **Teaching assistant (20 hours)**, *Computer Programming Laboratory 1*, Bachelor degree in
01/02/2021 Computer Science, University of Pisa
I helped student with exercises and homework in Javascript.
- 16/11/2020 - **Teacher (24 hours)**, *Machine Learning module*, Data Science course, Tree s.r.l.
03/12/2020 I taught the theoretical foundations of machine learning: from linear regression to feedforward neural networks and convolutional neural networks for both supervised and unsupervised learning. I also introduced computer vision fundamentals and helped the students in the design of their final project.

- 17/11/2020 **High-school lecture (2 hours)**, *Gobetti-Volta, Bagno a Ripoli (FI)*
Lecture on feedforward neural network and intuition behind backpropagation.
- 01/10/2019 - **Teaching assistant (20 hours)**, *Smart Applications*, Master degree in Computer Science,
01/02/2020 University of Pisa
I provide assistance to Prof. Vincenzo Gervasi in the management of the students for the final project of the course. There were 2 practical projects, half of the class worked on the first one, the other half on the second one. Me and Prof. Gervasi switched between one group and the other during lectures to assist the students and provide help in the implementation and methodologies.

Events organization

- 2023 **Collector**, *Deep Continual Learning Dagstuhl Seminar*
Editorial assistance for the final report of the seminar.
- 2023 **General Co-Chair**, *1st ContinualAI Unconference*
General Chairs: all ContinualAI Board Members
- 2022 **PC Member**, *Conference on Lifelong Learning Agents - CoLLAs*
- 2022 **Co-Organizer**, *Continual Learning and Emergence of Intelligent Systems: Theory and Application, Special Session*, 2022 IEEE World Congress on Computational Intelligence (WCCI), International Joint Conference on Neural Networks (IJCNN)
- 2022 **Co-Organizer**, *Advances in Continual Learning: beyond Catastrophic Forgetting, Special Session*, 2022 IEEE International Conference on Evolving and Adaptive Intelligent Systems (EAIS)
- 2021 **PC member**, *International Conference on AI for People (CAIP)*
- 2021 **Technical & web chair**, *Continual Learning in Computer Vision (CLVISION) workshop*, CVPR 2021
- 2021 **PC member**, *International Workshop on Continual Semi-Supervised learning (CSSL)*, IJCAI 2021
- 2021 **PC member**, *AI for People special issue*, *AI & Society Journal of Culture, Knowledge and Communication*, Springer

Reviewer service

Neural Networks, *Elsevier*

Transactions on Neural Networks and Learning Systems (TNNLS), *IEEE*

Transactions on Pattern Analysis and Machine Intelligence (TPAMI), *IEEE*

Machine Learning, *Springer*

Artificial Intelligence Review, *Springer*

Frontiers in Neurorobotics, *Frontiers*

Frontiers in Robotics and AI Human-Robot Interaction, *Frontiers*

National Science Centre Poland, *Grant Reviewer*

Open source projects and libraries

- 2021-present **Avalanche**, *Maintainer*
Open-source library for continual learning
<https://github.com/ContinualAI/avalanche>
- 2022-present **Continual Learning Baselines**, *Main maintainer*
Reproducing continual learning results from popular papers with Avalanche
<https://github.com/ContinualAI/continual-learning-baselines>
- 2021-present **ContinualAI wiki**, *Main maintainer*
Resources on continual learning
<https://wiki.continualai.org/>

Talks

- 23/03/2023 **Deep Continual Learning Dagstuhl Seminar**, *Dagstuhl, Germany*, Invited Talk, Beyond Forgetting with Continual Pre-Training
Introducing the Continual Pre-Training framework and its opportunities for the future of Continual Learning research.
- 21/09/2022 **Tenth International Workshop DICE2022: Spacetime - Matter - Quantum Mechanics**, *Castiglioncello*, Invited Talk, Non Smettere Mai di Imparare: verso un'IA più umana
Talk in Italian on Continual Learning for a public audience.
- 31/05/2022 **University of Verona, Computer Science Department**, Invited Talk, Continual Learning: from zero to hero
Introduction to Continual Learning (1 hour) and hands-on session by coding from scratch and with Avalanche a Continual Learning system learning to classify a stream of images (1 hour).
- 2021 **The Web Conference Workshop on Graph Benchmarks Learning (GLB)**
Presenting the paper "Catastrophic Forgetting in Deep Graph Networks: an Introductory Benchmark for Graph Classification"
- 2021 **1st International Conference on AI for People: Towards Sustainable AI**
Presenting the paper "Sustainable Artificial Intelligence through Continual Learning"
- 2021 **European Symposium on Artificial Neural Networks (ESANN)**
Presenting the paper "Continual learning with Echo State Networks"
- 2021 **Continual AI Seminars, Invited talk**
Presenting the paper "Continual learning for recurrent neural networks: An empirical evaluation"
- 2021 **Continual AI Seminars, Invited talk**
Presenting the paper "Continual Learning with Gated Incremental Memories"
- 2020 **International Joint Conference on Neural Networks (IJCNN)**
Presenting the paper "Continual Learning with Gated Incremental Memories"

Publications

- 2023 A. Carta, L. Pellegrini, A. Cossu, H. Hemati, and V. Lomonaco. *Avalanche: A PyTorch Library for Deep Continual Learning*. 2023. DOI: 10.48550/arXiv.2302.01766.
- A. Ceni, A. Cossu, J. Liu, M. Stölzle, C. D. Santina, C. Gallicchio, and D. Bacciu. "Randomly Coupled Oscillators for Time Series Processing". In: *ICML Workshop on New Frontiers in Learning, Control, and Dynamical Systems*. July 9, 2023.
- A. Cossu. "Towards Real-World Data Streams for Deep Continual Learning". PhD thesis. Pisa: Scuola Normale Superiore, 2023.
- A. Cossu, F. Spinnato, R. Guidotti, and D. Bacciu. "A Protocol for Continual Explanation of SHAP". In: *European Symposium on Artificial Neural Networks*. European Symposium on Artificial Neural Networks (ESANN). ESANN, 2023.
- H. Hemati, A. Cossu, A. Carta, J. Hurtado, L. Pellegrini, D. Bacciu, V. Lomonaco, and D. Borth. "Class-Incremental Learning with Repetition". In: *Proceedings of the 2nd Conference on Lifelong Learning Agents*. COLLA. Montreal, QC, Canada, 2023.
- A. Soutif-Cormerais, A. Carta, A. Cossu, J. Hurtado, V. Lomonaco, J. Van de Weijer, and H. Hemati. "A Comprehensive Empirical Evaluation on Online Continual Learning". In: *ICCV Visual Continual Learning Workshop*. ICCV Workshop. Aug. 20, 2023.
- 2022 A. Carta, A. Cossu, F. Errica, and D. Bacciu. "Catastrophic Forgetting in Deep Graph Networks: A Graph Classification Benchmark". In: *Frontiers in Artificial Intelligence* 5 (2022).
- A. Cossu, G. Graffieti, L. Pellegrini, D. Maltoni, D. Bacciu, A. Carta, and V. Lomonaco. "Is Class-Incremental Enough for Continual Learning?" In: *Frontiers in Artificial Intelligence* 5 (2022).

- A. Cossu, T. Tuytelaars, A. Carta, L. Passaro, V. Lomonaco, and D. Bacciu. "Continual Pre-Training Mitigates Forgetting in Language and Vision". In: (2022).
- F. Matteoni, A. Cossu, C. Gallicchio, V. Lomonaco, and D. Bacciu. "Continual Learning for Human State Monitoring". In: *30th European Symposium on Artificial Neural Networks, Computational Intelligence and Machine Learning*. 2022.
- A. Rosasco, A. Carta, A. Cossu, V. Lomonaco, and D. Bacciu. "Distilled Replay: Overcoming Forgetting Through Synthetic Samples". In: *Continual Semi-Supervised Learning*. Ed. by F. Cuzzolin, K. Cannons, and V. Lomonaco. Lecture Notes in Computer Science. Cham: Springer International Publishing, 2022, pp. 104–117. DOI: 10.1007/978-3-031-17587-9_8.
- M. Sangermano, A. Carta, A. Cossu, and D. Bacciu. "Sample Condensation in Online Continual Learning". In: *Proceedings of the 2022 International Joint Conference on Neural Networks*. 2022.
- 2021 A. Carta, A. Cossu, F. Errica, and D. Bacciu. "Catastrophic Forgetting in Deep Graph Networks: An Introductory Benchmark for Graph Classification". In: *The 2021 Web Conference (WWW) Workshop on Graph Benchmarks Learning (GLB)*. 2021.
- A. Carta, A. Cossu, V. Lomonaco, and D. Bacciu. "Ex-Model: Continual Learning from a Stream of Trained Models". In: *2022 IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshops (CVPRW)*. IEEE, 2021.
- A. Cossu, D. Bacciu, A. Carta, C. Gallicchio, and V. Lomonaco. "Continual Learning with Echo State Networks". In: *29th European Symposium on Artificial Neural Networks, Computational Intelligence and Machine Learning*. 2021. DOI: 10.14428/esann/2021.ES2021-80.
- A. Cossu, A. Carta, V. Lomonaco, and D. Bacciu. "Continual Learning for Recurrent Neural Networks: An Empirical Evaluation". In: *Neural Networks* 143 (2021), pp. 607–627. DOI: 10.1016/j.neunet.2021.07.021.
- A. Cossu, M. Ziosi, and V. Lomonaco. "Sustainable Artificial Intelligence through Continual Learning". In: *Proceedings of the 1st International Conference on AI for People: Towards Sustainable AI*. EAI, 2021.
- V. Lomonaco, L. Pellegrini, A. Cossu, A. Carta, G. Graffieti, T. L. Hayes, M. De Lange, M. Masana, J. Pomponi, G. M. van de Ven, M. Mundt, Q. She, K. Cooper, J. Forest, E. Belouadah, S. Calderara, G. I. Parisi, F. Cuzzolin, A. S. Tolia, S. Scardapane, L. Antiga, S. Ahmad, A. Popescu, C. Kanan, J. van de Weijer, T. Tuytelaars, D. Bacciu, and D. Maltoni. "Avalanche: An End-to-End Library for Continual Learning". In: *2021 IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshops (CVPRW)*. IEEE, 2021, pp. 3595–3605. DOI: 10.1109/CVPRW53098.2021.00399.
- G. Merlin, V. Lomonaco, A. Cossu, A. Carta, and D. Bacciu. "Practical Recommendations for Replay-based Continual Learning Methods". In: *Workshop on Novel Benchmarks and Approaches for Real-World Continual Learning (CL4REAL)* (2021).
- 2020 A. Cossu, A. Carta, and D. Bacciu. "Continual Learning with Gated Incremental Memories for Sequential Data Processing". In: *2020 International Joint Conference on Neural Networks (IJCNN)*. 2020, pp. 1–8. DOI: 10.1109/IJCNN48605.2020.9207550.

Industrial collaborations

2014–2019 **R&D, partner**, KLINK, Florence, Italy

I designed and implemented the KLINK services related to network analysis and agent-based modelling and simulation. I participated in the sales activity and worked on a number of different projects based on these services for companies and organizations. In most cases, I took care of the final dissemination of the results directly to the client.

Programming languages and frameworks

Python, Tensorflow, Keras, Pytorch, experienced user

C, Java, former user

Languages

Italian Mother tongue

English Professional knowledge

French Basic knowledge