Computer Science Department
Largo Bruno Pontecorvo, 3
56127, Pisa (PI), Italy
cossu48@gmail.com
https://www.andreacossu.com/
AndreaCossu
Cossu94
andrea-cossu

Andrea Cossu

Curriculum Vitae

Personal Statement

I am a post-doc researcher at University of Pisa. My research focuses on Deep Learning and Continual Learning, with the aim of designing Deep Learning agents that learn *over time without forgetting previous knowledge*. My research has been applied to the continual update of pre-trained and foundation models, as well as to recurrent models in non-stationary environments.

Google Scholar metrics

March 11, 2024 **H-Index: 10, Citations: 435**
Full list of publications provided below.

Research Positions

May 1, 2023 - ongoing **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.

Dec. 12, 2022 - March 3, 2023 **Research Intern**, *Google Brain, Brain Applied Research Team*, Mountain View, California, Dr. Abhijit Ogale
Few-Shot Personalization with Vision-Language Transformers

Feb. 1, 2022, April 30, 2022 **Visiting researcher**, *KU Leuven*, ESAT department, PSI group, Prof. Tinne Tuytelaars
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 ath 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

Research Projects

2023-2026 **Task Leader**, *Emergent Awareness from Minimal Collectives (EMERGE)*, European Innovation Council (EIC), Horizon 2021 EIC Pathfinder challenges, Grant Agreement 101070918
EMERGE will deliver a new philosophical, mathematical, and technological framework to demonstrate, both theoretically and experimentally, how a collaborative awareness – a representation of shared existence, environment and goals – can arise from the interactions of elemental artificial entities. The grant amount is about 3M euros. Task Leader of *T4.2: Life-long learning archetype units*. `https://eic-emerge.eu/`

Awards

2021 **Best library award**, *CLVision workshop at CVPR*, Avalanche: an End-to-End library for Continual learning
1,500 USD. Sponsor: Weights and Biases

2022 **Avalanche enters PyTorch ecosystem**

Supervision

2024 **Sergio Latrofa**, *Master Degree in Computer Science*, University of Pisa, Boosting non-linearity in reservoirs using Masked Intrinsic Plasticity
co-supervised with Andrea Ceni and Davide Bacciu

2024 **Giacomo Cignoni**, *Master Degree in Computer Science*, University of Pisa, A Framework for Continual Self Supervised Learning in an Online Setting
co-supervised with Antonio Carta

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

April 20, 2022 - May 10, 2022 **Teacher (20 hours)**, *Deep Learning laboratory*, Master in Big Data, University of Pisa
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.

Nov. 22, 2021 - December 20, 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/`
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.

April 19, 2021 - May 17, 2021
Teacher (20 hours), *Deep Learning laboratory*, Master in Big Data, University of Pisa
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.

August 19, 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.

Oct. 1, 2020 - February 1, 2021
Teaching assistant (20 hours), *Computer Programming Laboratory 1*, Bachelor degree in Computer Science, University of Pisa
I helped student with exercises and homework in Javascript.

Nov. 16, 2020 - Dec. 3, 2020
Teacher (24 hours), *Machine Learning module*, Data Science course, Tree s.r.l.
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.

Nov. 17, 2020
High-school lecture (2 hours), *Gobetti-Volta, Bagno a Ripoli (FI)*
Lecture on feedforward neural network and intuition behind backpropagation.

Oct. 1, 2019 - Feb. 1, 2020
Teaching assistant (20 hours), *Smart Applications*, Master degree in Computer Science, 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

2024 **Local Chair**, *Third edition of the Conference on Lifelong Learning Agents (CoLLAs)*
The leading conference on continual/lifelong learning, held in Pisa.

2023 **General Co-Chair**, *1st ContinualAI Unconference*
General Chairs: all ContinualAI Board Members. The event had 350 registered attendees and a pre-registration track published in Proceedings of Machine Learning Research (PMLR).

2023 **Collector**, *Deep Continual Learning Dagstuhl Seminar*
Editorial assistance for the final report of the seminar. Co-author of the report.

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

Editorial Positions

Associate Editor, *Neural Processing Letters*, Springer Nature

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`

Invited Talks and Tutorials

March 8, 2024 **University of Plymouth (UK)**, *Continual Learning lecture*
90-minute lecture on Continual Learning for master students and researchers of the University of Plymouth.

November 29, 2023 **3rd Artificial Intelligence for Electron Ion Collider Workshop**, *Catholic University of America, Washington, D.C.*, 1-hour tutorial titled "Continual Learning: taming non-stationary data streams"
Introduction to continual learning, possibility to apply it to particle accelerators and hands-on session in Python.

March 23, 2023 **Deep Continual Learning Dagstuhl Seminar**, *Dagstuhl, Germany*, Beyond Forgetting with Continual Pre-Training
Introducing the Continual Pre-Training framework and its opportunities for the future of Continual Learning research.

September 21, 2022 **Tenth International Workshop DICE2022: Spacetime - Matter - Quantum Mechanics**, *University of Pisa, Physics Department, Castiglioncello*, Non Smettere Mai di Imparare: verso un'IA più umana
Talk in Italian on Continual Learning for a public audience.

May 31, 2022 **University of Verona**, *Computer Science Department*, 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).

Contributed Talks

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**
Presenting the paper "Continual learning for recurrent neural networks: An empirical evaluation"

2021 **Continual AI Seminars**
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

A. Carta, A. Cossu, V. Lomonaco, D. Bacciu, and J. van de Weijer. "Projected Latent Distillation for Data-Agnostic Consolidation in Distributed Continual Learning". In: *currently under review*.

A. Ceni, A. Cossu, M. Stölzle, J. Liu, C. D. Santina, C. Gallicchio, and D. Bacciu. "Random Oscillators Network for Time Series Processing". In: *To appear in AISTATS 2024*.

A. Cossu, T. Tuytelaars, A. Carta, L. Passaro, V. Lomonaco, and D. Bacciu. "Continual Pre-Training Mitigates Forgetting in Language and Vision". In: *currently under review*.

2023 A. Carta, L. Pellegrini, A. Cossu, H. Hemati, and V. Lomonaco. "Avalanche: A PyTorch Library for Deep Continual Learning". In: *Journal of Machine Learning Research* 24.363 (2023), pp. 1–6.

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*. 2023.

A. Cossu. "Towards Real-World Data Streams for Deep Continual Learning". PhD thesis. Pisa: Scuola Normale Superiore, 2023. DOI: https://dx.doi.org/10.25429/cossu-andrea_phd2023-07-17.

A. Cossu, F. Spinnato, R. Guidotti, and D. Bacciu. "A Protocol for Continual Explanation of SHAP". In: *ESANN 2023 Proceedings*. Bruges (Belgium) and online: Ciaco - i6doc.com, 2023, pp. 501–506. DOI: 10.14428/esann/2023.ES2023-41.

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*. PMLR, 2023, pp. 437–455.

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: *Proceedings of the IEEE/CVF International Conference on Computer Vision Workshops*. 2023, pp. 3518–3528.

T. Tuytelaars, B. Liu, V. Lomonaco, G. van de Ven, and A. Cossu. "Deep Continual Learning (Dagstuhl Seminar 23122)". In: *Dagstuhl Reports* 13.3 (2023). Ed. by T. Tuytelaars, B. Liu, V. Lomonaco, G. van de Ven, and A. Cossu, pp. 74–91. DOI: 10.4230/DagRep.13.3.74.

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). DOI: https://doi.org/10.3389/frai.2022.824655.

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)*. 2022, pp. 3789–3798. DOI: 10.1109/CVPRW56347.2022.00424.

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). DOI: https://doi.org/10.3389/frai.2022.829842.

F. Matteoni, A. Cossu, C. Gallicchio, V. Lomonaco, and D. Bacciu. "Continual Learning for Human State Monitoring". In: *ESANN 2022 Proceedings*. Bruges (Belgium) and online event: Ciaco - i6doc.com, 2022, pp. 79–84. DOI: 10.14428/esann/2022.ES2022-38.

G. Merlin, V. Lomonaco, A. Cossu, A. Carta, and D. Bacciu. "Practical Recommendations for Replay-Based Continual Learning Methods". In: *Image Analysis and Processing. ICIAP 2022 Workshops*. Ed. by P. L. Mazzeo, E. Frontoni, S. Sclaroff, and C. Distante. Lecture Notes in Computer Science. Cham: Springer International Publishing, 2022, pp. 548–559. DOI: 10.1007/978-3-031-13324-4_47.

A. Rosasco, A. Carta, A. Cossu, V. Lomonaco, and D. Bacciu. "Distilled Replay: Overcoming Forgetting Through Synthetic Samples". In: *Continual Semi-Supervised Learning*. 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: *2022 International Joint Conference on Neural Networks (IJCNN)*. 2022, pp. 01–08. DOI: 10.1109/IJCNN55064.2022.9892299.

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. Cossu, D. Bacciu, A. Carta, C. Gallicchio, and V. Lomonaco. "Continual Learning with Echo State Networks". In: *ESANN 2021 Proceedings*. Online event (Bruges, Belgium): Ciaco - i6doc.com, 2021, pp. 275–280. 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. DOI: http://dx.doi.org/10.4108/eai.20-11-2021.2314097.

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. Tolias, 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.

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