

Andrea Cossu

Curriculum Vitae

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Personal Statement

I am a PhD Student in Data Science, under the supervision of Prof. Davide Bacciu, Dr. Vincenzo Lomonaco and Dr. Anna Monreale. My research focuses on Continual Learning, with applications to Recurrent Neural Networks models and sequential data processing.

Education

- 2019–2022 **PhD in Data Science**, *Scuola Normale Superiore and University of Pisa*, Italy
(ongoing) Continual learning with applications to sequential data processing and recurrent models
- 2017–2019 **Master Degree in Computer Science - AI curriculum**, *University of Pisa*, Italy
Thesis on continual learning with recurrent neural networks
- 2014–2017 **Bachelor Degree in Computer Science**, *University of Pisa*, Italy
Thesis on novelty detection with Echo State Networks

Affiliations

- 2019–2022 **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

Visiting

- 01/02/2022 – **Visiting researcher**, *KU Leuven*, ESAT department, PSI group, Prof. Tinne Tuytelaars
- 30/04/2022 Continual Learning with pretrained models and transformers for NLP and Vision
- 01/07/2020 – **Eastern European Machine Learning Summer School**, *Virtual Krakow Poland*, Deep Learning and Reinforcement Learning
- 09/07/2020 I followed the lectures and led a small team for the design proposal of a continual learning system, which I presented on behalf of the team at the summer school closing event.

Awards

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

Supervision

- 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*,
20/12/2021 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.
- 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

- 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*

Open source projects and libraries

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

Talks

- 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

- 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).
- 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).
- A. Rosasco, A. Carta, A. Cossu, V. Lomonaco, and D. Bacciu. "Distilled Replay: Overcoming Forgetting through Synthetic Samples". In: *1st International Workshop on Continual Semi-Supervised Learning (CSSL) at IJCAI*. 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