Matteo **Tiezzi, Ph.D.**

PostDoctoral Research Fellow · Artificial Intelligence and Machine Learning

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Research Summary: Working on Continual Learning and Graph Representation Learning. Foundational research on novel learning algorithms and neural architectures, investigating agents capable of processing and learning from continuous streams of data, mostly within dynamic visual environments. My main interest revolves around the concept of developing an agent that evolves over time, while "living" in the observed environment, receiving a few information (supervisions) from the user, and it also has the capability of asking for supervisions, when needed. Developing open-source libraries for training and inference in Graph Neural Networks. Published at NeurIPS, AAAI, IJCAI, TPAMI, TNNLS. Reviewer in all the major machine learning venues (NeurIPS, ICML, ICLR, etc.) and journals (TPAMI, TNNLS, Artificial Intelligence etc.)

Work Experience

PAVIS, Italian Institute of Technology (IIT), Postdoctoral Research Fellow

Genoa, Italy

Advisor: Alessio Del Bue — *June 2024-Present*

- Investigating Human-Robot Interaction (HRI) scenario and Behavioral cloning, finalized at developing Continual Lifelong Learning for Robotic Agents.
- Integrating exteroceptive and proprioceptive robot information for comprehensive environmental and self-awareness.

SAILab, University of Siena, Postdoctoral Research Fellow

Siena

Grant PRIN 2017 REXLEARN - Advisor: Prof. Stefano Melacci — *October 2020- April 2024*

- Investigated deep learning models for sequence modeling (Recurrent Neural Networks, Linear Transformers, State-space models)
- Unsupervised and self-supervised learning in the open-set class incremental and continual setting and video streams. This is carried on by enforcing spatio-temporal coherence in an unsupervised loss function.
- AI agents that learn autonomously from few amounts of real world data and interactions, inspired by how children learn over time.
- Reliability, interpretability of machine learning models and their robustness to adversarial attacks in visual environments.
- Developed benchmark datasets to evaluate the performances, reliability and robustness of algorithms and models in lifelong learning scenarios.
- Introduced novel neural architectures based on human-like focus of attention mechanisms, in order to hinder spurious correlations, foster continual learning schemes and improve computational capabilities for Computer Vision.
- Investigated and explored the usage of GNNs to speed-up and generalize graph visualization in the area of Graph Drawing.

isTech

Pistoia, Italy

Six months scholarship as a graduate intern student at IsTech, Pistoia, Italy — *2017*

- Research internship for the validation of a prototype system for vehicle traffic events monitoring. Collected and preprocessed data, contributed on the engineering and design of datasets. Devised architectures, training and testing pipelines for the proposed solution. Deployment of the proposed solution in a real world environment.

QuestIt

DIISM. Siena, Italy

Three months scholarship as an undergraduate student at QuestIt, Siena, Italy — *2014*

- Usage of XPath to extract relevant information from web pages as input to the sentiment analysis tool MySnooper.

Courses: Graph Neural Networks and Neural-Symbolic Computation

MAASAI, Universite Cote d'Azur (Nice, France) and UNIFI (Florence, Italy)

Course assistant, seminar, lecturer and organization of the laboratory session — *2021, 2022*

- International M.Sc. course, 2022, MAASAI, Universite Cote d'Azur
- PhD and M.Sc. course, 2021, MAASAI, Universite Cote d'Azur and UNIFI (Florence, Italy)
- Deep Learning Summer School @ UCA, 2021, UCA, Nice, France

Education

Ph.D. in Information Engineering and Machine Learning - Final grade: Excellent with honours

Siena, Italy

University of Siena, SAILab (Siena Artificial Intelligence Laboratory) — *2020*

- Three years PhD Scholarship at the Department of Information Engineering, University of Siena, Italy
- *Thesis title* : Local Propagation in Neural Network Learning by Architectural Constraints; *Advisor*: Prof. Marco Maggini
- Foundational studies on novel learning algorithms for feedforward neural networks and Graph Neural Networks (GNNs). Development of open-source code multi-platform (Tensorflow 1.x, PyTorch) libraries for GNN training and inference.
- Designed, developed and maintained code repositories to support result reproducibility.
- Presented at multiple international venues/conferences, represented the research group at external meetings/seminars and press interviews.

M.Sc. Computer and Automation Engineering - Final grade: 110/110 with honours

Siena, Italy

University of Siena — *2017*

- *Thesis title* : Traffic events monitoring with Recurrent Neural Networks; *Advisor*: Prof. Marco Maggini

B.Sc. Computer and Information Engineering - **Final grade: 108/110** *Siena, Italy*

University of Siena *2014*

- *Thesis title* : Automatic extraction of relevant information from Web pages using XPath; *Advisor*: Prof. Marco Maggini

Skills

Programming languages (sorted)	Python, C++, C
Frameworks and Tools	PyTorch, TensorFlow, OpenCV, SciPy, NumPy, Pandas, NetworkX, Git, Bash, Tmux
Document Preparation Systems	LaTeX, Markdown, Microsoft Office
Languages	Italian, English

Selected Publications

Conference Papers

NeurIPS 2020: Focus of Attention Improves Information Transfer in Visual Features *[DOI]*

M. Tiezzi, S. Melacci, A.Betti, M. Maggini, M. Gori *2020*

34th Conference on Neural Information Processing Systems

IJCAI-ECAI 2022: Stochastic Coherence Over Attention Trajectory For Continuous Learning In Video Streams *[DOI]*

M. Tiezzi, S. Marullo, L. Faggi, E. Meloni, A. Betti and S. Melacci *2022*

31st International Joint Conference on Artificial Intelligence

AAAI 2022: Being Friends Instead of Adversaries: Deep Networks Learn from Data Simplified by Other Networks *[DOI]*

S. Marullo, M. Tiezzi, M. Gori, S. Melacci *2022*

AAAI Conference on Artificial Intelligence

AAAI 2024: Neural Time-Reversed Generalized Riccati Equation *[ArXiv]*

A. Betti, M. Casoni, M. Gori, S. Marullo, S.Melacci and M. Tiezzi *2024*

AAAI Conference on Artificial Intelligence

CoLLas 2024: Memory Head for Pre-Trained Backbones in Continual Learning *[DOI]*

M. Tiezzi, F. Becattini, S.Marullo and S.Melacci *2024*

3rd Conference on Lifelong Learning Agents

CoLLas 2022: Continual Unsupervised Learning for Optical Flow Estimation with Deep Networks *[DOI:TBA]*

S. Marullo, M. Tiezzi, A. Betti, L. Faggi, E. Meloni, S. Melacci *2022*

1st Conference on Lifelong Learning Agents

ECML-PKDD 2022: Foveated Neural Computation *[DOI]*

M. Tiezzi, S. Marullo, A. Betti, E. Meloni, L. Faggi, M. Gori and S. Melacci *2022*

23rd European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases

IJCNN 2023: Continual Learning with Pretrained Backbones by Tuning in the Input Space *[ArXiv]*

S. Marullo, M. Tiezzi, M. Gori, S. Melacci, T. Tuytelaars *2023*

International Joint Conference on Neural Networks

ECAI2020: A Lagrangian Approach to Information Propagation in Graph Neural Networks *[DOI]*

M. Tiezzi, G. Marra, S. Melacci, M. Maggini, M. Gori *2020*

European Conference on Artificial Intelligence

IJCNN2020: Local Propagation in Constraint-based Neural Networks *[DOI]*

G.Marra, M. Tiezzi, S. Melacci, A.Betti, M. Maggini, M. Gori *2020*

International Joint Conference on Neural Networks

ANNPR 2018: Inductive–transductive learning with Graph Neural Networks *[DOI]*

A. Rossi, M. Tiezzi, GM. Dimitri, M. Bianchini, M. Maggini, F. Scarselli *2018*

Artificial Neural Networks in Pattern Recognition: 8th IAPR TC3 Workshop

Journals

Neural Networks: Continual learning of conjugated visual representations through higher-order motion flows *[DOI]*

S.Marullo,, M. Tiezzi, M. Gori, S. Melacci *2022*

Elsevier Neural Networks

TPAMI: Deep Constraint-based Propagation in Graph Neural Networks *[DOI]*

M. Tiezzi, G. Marra, S. Melacci, M. Maggini *2020*

IEEE Transactions on Pattern Analysis and Machine Intelligence

TNNLS: Graph neural networks for graph drawing [DOI]

M. Tiezzi, G. Ciravegna and M. Gori 2022

IEEE Transactions on Neural Networks and Learning Systems

Pre-prints

State-Space Modeling in Long Sequence Processing: A Survey on Recurrence in the Transformer Era [ArXiv]

M. Tiezzi, M. Casoni, A. Betti, M. Gori and S.Melacci 2024

Under Review

Selected Projects

The Graph Neural Network Framework [Link]

Documentation: http://sailab.diism.unisi.it/gnn/ 2018/2020

*Tensorflow 1.x **(link)** and PyTorch **(link)** implementations of the original GNN model*

Foveated Convolutional Layers [Link]

Documentation **(link)** 2022

PyTorch package for the Foveated Convolutional Layers (FCL)

Program Committees & Peer Reviewer

PC Member: ECML-PKDD2024, AAAI2023, IJCA-ECAI2022, ICANN2022, AAAI2022

Peer Reviewer: **International Conferences:** ICML 2024, ICLR 2024, NeurIPS 2023, IJCAI 2023, IJCAI-ECAI 2022, ICPR 2022, ICANN 2019. **Journals:** IEEE TPAMI, IEEE TNNLS, IEEE TKDE, Artificial Intelligence Journal, Knowledge-Based Systems (KNOSYS), Neurocomputing, AI Open

Students supervision

M.Sc. Thesis "FovEx - Foveation based Explanations for deep neural networks" *Erlangen-Nürnberg, Germany*

Co-advisor of the student Mahadev Panda 2024

M.Sc. Thesis "Aggregation Functions in Graph Neural Networks" *Siena, Italy*

Co-advisor of the student Faezeh Amou Najafabadi 2022

B.Sc. Thesis "Real world experimentation of Systems for Video Object Detection" *Siena, Italy*

Co-advisor of the student Giulio Campagna 2018

Speaker and organization

Learning Over Time Spring School - LOT 2025 *Siena, Italy*

Organizer March 2024

3rd Conference on Lifelong Learning Agents - CoLLas 2024 *Pisa, Italy*

Local Chair July 2024

ACDL Workshop on Graph Neural Networks *Siena, Italy*

Organizer and Speaker July 2019

Competitions, Grants & Awards

2022 **Special Mention**, "Marco Cadoli" prize for Best PhD thesis on Artificial Intelligence *AIxIA*

2018 **Hackaton**, SoBigData Soccer Data Challenge, member of the winning team and main speaker *Pisa, Italy*

2018 **Scholarship**, Recurrent neural networks for vehicle traffic event and state monitoring, *DIISM and IsTech*

2017 **Scholarship**, Three years Ph.D. Scholarship at Department of Information Engineering *Siena, Italy*

2017 **"Matteo Lanzoni" Prize** , winner of the best thesis award on road safety *Florence, Italy*