

DAVIDE COCCOMINI

EXPERIENCE

Research Associate at Italian National Research Council (CNR)

Pisa - Nov 2021 - Today

- Performed research in Deep Learning and Computer Vision achieving state-of-the-art results in the field of video deepfake detection and exploring other areas of research as well producing more than 10 papers on conferences and journals
- Reviewed dozens of papers about Machine Learning, Computer Vision and Deepfake Detection on TOMM, ICMR, PeerJ, ICASSP, Jol and JVIS

Machine Learning Engineer at Wevo SRL

Pisa - May 2023 - Sep 2023

- Developed a face detection and age, sex and ethnicity classification system based on Convolutional Neural Networks
- Developed an image cartoon detection filter based on Swin Transformers

Visiting Researcher at Centre for Research & Technology Hellas (CERTH)

Thessaloniki - Jun 2022 - Jul 2022

- Designed and developed a video deepfake detection system based on vision transformers capable of effectively handling multiple identities in videos and catching both temporal and spatial anomalies

Technical Writer at Towards Data Science

Remote - Jun 2021 - Today

- Written and published several articles about Vision Transformers, AI, Hebbian Learning and Climate Change with over 75000 views

Search Engine Evaluator at Appen

Remote - Sep 2018 - Sep 2021

- Evaluated the quality of Google search results and Facebook ads to create datasets for machine learning

Software Engineer Freelancer at Altragamma SRL

Remote - May 2019 - Aug 2019

- Developed a mobile application using React-Native and PHP for Android and iOS used by hundreds of people
- Improved the website style and functionalities conducting to more than 50 local producers subscribers

Software Engineer Intern at Macs Tech

Pisa - Jun 2018 - Nov 2018

- Worked on software to manipulate hyperspectral images using OpenCV improving analysis speed from minutes to seconds
- Realized a software for image similarity comparison using Lab-SSIM reducing costs and times for the process of 90%

EDUCATION

PhD

Nov 2021 - Today

PhD in Information Engineering | University of Pisa

Exams:

- Credibility assessment in social media with a focus on social bot detection
- End-user Creation and Control of Daily Automations in Intelligent Environments
- Ethics of AI
- English for Research
- Machine Vision
- Multimodal Machine Learning
- Neural Models and Techniques in Natural Language Processing and Information Retrieval
- Smart Approach and Visual Design to organizational problem solving

Master's Degree

Feb 2019 - Jul 2021

Master's degree in Artificial Intelligence and Data Engineering | LM-32 Ingegneria Informatica | University of Pisa

Final Grade: 110/110 cum laude

Thesis: Design and Development of Transformer-based Methods for Video Deepfake Detection

The aim of the thesis was to develop new methods obtained by combining various types of Vision Transformers and EfficientNets or convolutional networks from scratch to perform video deepfakes detection obtaining results close to the state of the art and outperforming other approaches on some of the main datasets in this field.

Supervisors: Prof. Fabrizio Falchi, Prof. Claudio Gennaro, Dott. Nicola Messina

Exams:

- Advanced Business and Project Management: 30
- Cloud Computing: 29
- Computational Intelligence and Deep Learning: 30
- Data Mining and Machine Learning: 28
- Innovation Management: 27

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- Internet of Things: 30
- Large-Scale and Multi-Structured Databases: 30
- Mobile and Social Sensing Systems: 28
- Multimedia Information Retrieval and Computer Vision: 30
- Optimization Methods and Game Theory: 26
- Process Mining and Intelligence: 29
- Symbolic and Evolutionary Artificial Intelligence: 29
- UI/UX Design: 30L

Bachelor's Degree

Sep 2014 – Feb 2019

Bachelor's degree in Computer Engineering | L-8 Ingegneria dell'Informazione | University of Pisa

Final Grade: 89/110

Thesis: Analysis of the perception of chromatic differences as the resolution changes using an artificial neural network

The aim of the thesis was to reduce the time required to check the quality of color perception in industrial printing processes by developing a neural network capable of identifying excessive print degradation.

Supervisors: Prof. Beatrice Lazzerini, Dott. Francesco Pistolesi

Summer School

Sep 2023

Summer School in Large Scale AI for Research and Industry | UNIMORE – Nvidia – CINECA – ELLIS

Project: Develop deep learning system to estimate per-object distance, working on the LEONARDO supercomputer

SKILLS

Main experience and knowledge in the fields of Deep Learning and Neural Networks, with a focus on image analysis applied to Deepfake Detection, Medical Imaging for Diagnosis, Hebbian Learning, Anomaly Detection and Generative AI.

Programming and Markup: Python • JavaScript • C# • Java • C++ • PHP • C • HTML • CSS

Data Management: Relational Databases • MongoDB • Neo4j • LevelDB

AI: Neural Networks • Machine Learning • Deep Learning • Computer Vision • Generative AI • NLP • Multimodal ML • Anomaly Detection • Deepfake Detection • Hebbian Learning

Frameworks and libraries: Pytorch • TensorFlow • OpenCV • Scikit-Learn • Hadoop • Spark • React-Native • Bootstrap

Soft Skills: Leadership • Teamwork • Public speaking

Languages: Italian (Native) • English (C1)

PARTICIPATION IN PROJECTS

ISCRA-C LEONARDO Super Computer

2023

Presented and won an ISCRA-C project request to CINECA earning the access to 80000 GPU hours on LEONARDO super computer in order to conduct research on Synthetic Image Detection.

FAIR

2023

Published 1 paper supported by FAIR (PE00000013) funded by the European Commission under the EU-NGEU on Synthetic images detection.

AI4Media

2022 - 2023

Published 4 papers supported by the European project AI4Media (GA n. 951911) on real-world robust Deepfake Detection Models, generalization analysis of Deepfake Detection methods, Synthetic images detection and Adversarial Attacks on Deepfake Detection. Participated as a Research Fellow also in the AI4Media Fellowship Program with an exchange between the CNR of Pisa and CERTH of Thessaloniki.

SERICS

2023

Published 2 papers supported by SERICS (PE00000014) under the NRRP MUR program funded by the EU-NGEU on Synthetic images detection, Adversarial Attacks on Deepfake Detection and generalization analysis of Deepfake Detection methods.

COMPETITIONS

• 1st out of 4 teams at ELSA Media Analytics and Deepfake Detection International Conference on Computer Vision ICCV (CORE Rank: A*) competition

2023

• Judge at Video Browser Showdown – The Video Retrieval Competition

2023

• 4th out of 105 teams at Kaggle Wikipedia Image-Caption Matching

2022

• 4th out of 7 teams at ICIAP Deepfake Images Detection and Reconstruction Challenge

2022

• 4th out of 15 teams at Copernicus Hackathon Vicenza

2020

• 38th in Italy out of hundreds of teams at Google Hash Code

2018-2021

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Journals

- Coccomini, D.A., Caldelli, R., Falchi, F., Gennaro, C. (2023) On the Generalization of Deep Learning Models in Video Deepfake Detection. *Journal of Imaging (Scimago - Computer Vision and Pattern Recognition Rank: Q2)*, Vol 9, Num. 5, Article Number 89, ISSN: 2313-433X, DOI: 10.3390/jimaging9050089
- Guarnera, L., Giudice, O., Guarnera, F., Ortis, A., Puglisi, G., Paratore, A., Bui, L.M.Q., Fontani, M., Coccomini, D.A., Caldelli, R., Falchi, F., Gennaro, C., Messina, N., Amato, G., Perelli, G., Concas, S., Cuccu, C., Orrù, G., Marcialis, G.L., Battiato, S. (2022). The Face Deepfake Detection Challenge. *Journal of Imaging (Scimago - Computer Vision and Pattern Recognition Rank: Q2)*, Vol. 8, Num. 10, Article Number 263, ISSN: 2313-433X, DOI: 10.3390/jimaging8100263
- Messina, N., Coccomini, D.A., Esuli, A., Falchi, F. (2022) Cascaded Transformer-based Networks for Wikipedia Large-scale Image-Caption Matching, *Multimedia Tools And Applications MTAP (Scimago - Media Technology Rank: Q1)*. ISSN: 1380-7501 (Accepted – Waiting for publication)
- Coccomini, D.A., Zilos, G.K., Amato, G., Caldelli, R., Falchi, F., Papadopoulos, S., Gennaro, C. (2022). MINTIME: Multi-Identity Size-Invariant Video Deepfake Detection, *IEEE Transactions on Information Forensics and Security TIFS (Scimago - Computer Networks and Communications Rank: Q1)*. ISSN: 1556-6013 (Submitted)
- Coccomini, D.A., Esuli, A., Falchi, F., Gennaro, C., and Amato, G. (2023). Detecting Images Generated by Diffusers, *PeerJ Computer Science (Scimago – Computer Science Rank: Q2)*. ISSN: 2376-5992 (Submitted)

Conferences

- Coccomini, D.A., Messina, N., Gennaro, C., Falchi, F. (2022). Combining EfficientNet and Vision Transformers for Video Deepfake Detection. In: Sclaroff, S., Distant, C., Leo, M., Farinella, G.M., Tombari, F. (eds) *Image Analysis and Processing – ICIAP 2022 (CORE Rank: B)*. Lecture Notes in Computer Science, Vol. 13233. Springer, Cham. ISBN: 978-3-031-06432-6, DOI: 10.1007/978-3-031-06433-3_19, Code: <https://github.com/davide-coccomini/Combining-EfficientNet-and-Vision-Transformers-for-Video-Deepfake-Detection>
- Coccomini, D. A., Caldelli R., Falchi, F., Gennaro, C., Amato, G. (2022). Cross-Forgery Analysis of Vision Transformers and CNNs for Deepfake Image Detection. In *Proceedings of the 1st International Workshop on Multimedia AI against Disinformation (MAD '22)* organized with the ACM International Conference on Multimedia Retrieval ICMR (CORE Rank: B). Association for Computing Machinery, New York, NY, USA, (pp 52–58). ISBN: 978-1-4503-9242-6/22/06, DOI:10.1145/3512732.3533582, Code: <https://github.com/davide-coccomini/Cross-Forgery-Analysis-of-Vision-Transformers-and-CNNs-for-Deepfake-Image-Detection>
- Messina, N., Coccomini, D.A., Esuli, A., Falchi, F., (2022) Transformer-Based Multi-modal and Re-Rank for Wikipedia Image-Caption Matching. In *Wiki-M3L workshop, co-located with International Conference on Learning Representations ICLR (CORE Rank: A*)*, Lisbon, Portugal
- Bailer, W., Arnold, R., Benz, V., Coccomini, D. A., Gkagkas, A., Guðmundsson, G.P., Heller, S., Jónsson, B.P., Lokoc, J., Messina, N., Pantelidis, N., Wu, J. (2023). Improving Query and Assessment Quality in Text-Based Interactive Video Retrieval Evaluation. In *Proceedings of the 2023 ACM International Conference on Multimedia Retrieval ICMR '23 (CORE Rank: B)*, (pp. 597-601). Association for Computing Machinery, New York, NY, USA. ISBN: 979-8-4007-0178-8, DOI: 10.1145/3591106.3592281
- Vairo, C., Coccomini, D.A., Falchi, F., Gennaro, C., Massoli, F.V., Messina, N., Amato, G. (2022). AIMH Lab for Cybersecurity. In *Ital-IA 2022 - Workshop on AI for Cybersecurity*. URL: https://www.ital-ia2022.it/articoli/documenti/cybersecurity/Ital-IA22_paper_152.pdf
- Coccomini, D.A., Caldelli, R., Esuli, A., Falchi, F., Gennaro, C., Messina, N., Amato, G. (2023). AIMH Lab Approaches for Deepfake Detection. In: *Proceedings of the Italia Intelligenza Artificiale - Thematic Workshops co-located with the 3rd CINI National Lab AIIS Conference on Artificial Intelligence (Ital IA 2023)*, Pisa, Italy, May 29-30, 2023, CEUR Workshop Proceedings (pp. 432-436), Vol. 3486. ISSN: 1613-0073, URL: <https://ceur-ws.org/Vol-3486/32.pdf>
- Vecchio, A., Anastasi, G., Coccomini, D.A., Guazzelli, S., Lotano, S., Zara, G. (2019). Labeling of Activity Recognition Datasets: Detection of Misbehaving Users. In *Proceedings of International Conference on Wireless Mobile Communication and Healthcare* (pp. 320-331). Vol 320. Springer, Cham. ISBN: 978-3-030-49288-5, DOI: 10.1007/978-3-030-49289-2_2
- Coccomini, D.A. (2023) Deepfake Detection: Challenges and Solutions. In: *31st Symposium on Advanced Database Systems SEBD (Doctoral Consortium)*, Galzignano Terme, Italy. CEUR Workshop Proceedings (pp. 688-689), Vol. 3478. ISSN: 1613-0073. URL: <https://ceur-ws.org/Vol-3478/paper07.pdf>
- Coccomini, D. A., Caldelli R., Falchi, F., Gennaro, C., Amato, G. (2023). Adversarial Magnification to Deceive Deepfake Detection through Super Resolution. In *Proceedings of Workshop on Deep Learning and Multimedia Forensics. Combating fake media and misinformation, co-located in European Conference of Machine Learning ECML-PKDD (CORE Rank: A)*, Turin, Italy (Accepted - Waiting for publication)

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Reports

- Messina, N., Coccomini, D.A., Esuli, A., Falchi, F., (2022) Transformer-Based Multi-modal and Re-Rank for Wikipedia Image-Caption Matching. Arxiv Preprint. DOI: 10.48550/arXiv.2206.1043
- Coccomini, D.A., Zilos, G.K., Amato, G., Caldelli, R., Falchi, F., Papadopoulos, S., Gennaro, C. (2022). MINTIME: Multi-Identity Size-Invariant Video Deepfake Detection, Arxiv Preprint. DOI: 10.48550/arXiv.2211.10996. Code: <https://github.com/davide-coccomini/MINTIME-Multi-Identity-size-iNvariant-TIMEsformer-for-Video-Deepfake-Detection>
- Coccomini, D.A., Esuli, A., Falchi, F., Gennaro, C., and Amato, G. (2023). Detecting Images Generated by Diffusers, Arxiv Preprint. DOI: 10.48550/arXiv.2303.05275
- Coccomini, D.A., Messina N., Gennaro, C. and Falchi, F. (2021). Generative Adversarial Networks for Astronomical Images Generation, Arxiv Preprint. DOI: 10.48550/arXiv.2111.11578
- Aloia, N., Amato, G., Bartalesi, V., Benedetti, F., Bolettieri, P., Cafarelli, D., Carrara, F., Casarosa, V., Ciampi, L., Coccomini, D.A., Concordia, C., Corbara, S., Benedetto, M.D., Esuli, A., Falchi, F., Gennaro, C., Lagani, G., Lenzi, E., Meghini, C., Messina, N., Metilli, D., Molinari, A., Moreo, A., Nardi, A., Pedrotti, A., Pratelli, N., Rabitti, F., Savino, P., Sebastiani, F., Sperduti, G., Thanos, C., Trupiano, L., Vadicamo, L., Vairo, C. (2022). AIMH Research Activities 2022. CNR Technical Report, Num. 475648, DOI: 10.32079/isti-ar-2022/002

PRESENTATIONS

- Transformers in Vision: From Zero to Hero at AICamp with 244 attendees and more than 34.000 views (Youtube) 2022
URL: https://www.youtube.com/watch?v=J-utjBdLCTo&ab_channel=AICamp
- Transformers in Vision: From Zero to Hero at Deep Learning Italia with 100 attendees (Youtube) 2022
URL: https://www.youtube.com/watch?v=4A-E5RchG4o&ab_channel=DeepLearningItalia

SOFTWARE PROJECTS

MINTIME: Multi-Identity Size-Invariant Video Deepfake Detection

Implementation of the paper "MINTIME: Multi-Identity Size-Invariant Video Deepfake Detection".

Code: <https://github.com/davide-coccomini/MINTIME-Multi-Identity-size-iNvariant-TIMEsformer-for-Video-Deepfake-Detection>

Combining EfficientNet and Vision Transformers for Video Deepfake Detection

2022

Implementation of the paper "Combining EfficientNet and Vision Transformers for Video Deepfake Detection".

Code: <https://github.com/davide-coccomini/Combining-EfficientNet-and-Vision-Transformers-for-Video-Deepfake-Detection>

Cross-Forgery Analysis of Vision Transformers for Video Deepfake Detection

2022

Implementation of the paper "Cross-Forgery Analysis of Vision Transformers for Video Deepfake Detection".

Code: <https://github.com/davide-coccomini/Cross-Forgery-Analysis-of-Vision-Transformers-and-CNNs-for-Deepfake-Image-Detection>

Cancer Detection from Medical Images

2021

Implemented Deep Learning models based on Convolutional Neural Networks and various pretrained models for classification of malignant masses and calcifications achieving up to 87% accuracy.

Code: <https://github.com/davide-coccomini/Convolutional-Neural-Network-for-Medical-Imaging-Analysis-Abnormality-detection-in-mammography>

South Valley Roleplay

2012 - 2023

Founded an online roleplay game became one of the most important servers of SA:MP in Italy with thousands of players in the years. I worked as a community and staff manager managing up to 50 people taking care of the growth of the whole project and in the last years also of the developers training.

Images Similarity Search

2021

Implemented an images search engine using Deep Learning and similarity search methodologies obtaining a system able to retrieve results of thousands of images in up to 0.1 second.

Large Scale Databases Applications

2020

- Created a Java application for natural disasters monitoring based on MongoDB showing several data visualizations
- Developed a Java application for Google Scholar tracking scraped data and storing them using Neo4j
- Contributed to Scholarly public GitHub repository fixing relevant bugs in web scraping using Python

Code: <https://github.com/davide-coccomini/LSDataBase>

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Brain-based Wheelchair Control

2020

Designed the process of developing a wheelchair controlled through the use of a helmet and an on-board computer capable, through Machine Learning systems, of translating the user's thoughts into movements to be made by the chair.

Tornado Forecasting

2019

Collected, combined and elaborated meteorological data from Copernicus and NOAA to train a K-nearest neighbors classifier able to predict tornados. Using the trained model it was possible to perform tornado prediction up to 5 days before and with 83% of accuracy. The whole project was developed using Python and Scikit-learn.

Code: <https://github.com/davide-coccomini/Predicting-Tornadoes-days-ahead-with-Machine-Learning>

Runtics

2018

Developed a mobile brain teaser using React Native and React Redux. The app reached the 800 downloads on Android and iOS in one month. I took care of the project from the planning to the development up to the advertising.

Code: <https://github.com/davide-coccomini/Runtics>

Fanta Vikings and Fanta-GOT

2017 - 2019

- Founded Fanta Vikings working as a web developer, staff leader and community manager reaching up to 1000 subscribers

- Led the team, projected and realized Fanta-GOT International with 14000 players from Europe and US

Code: <https://github.com/davide-coccomini/Fanta-GOT>

Infrastructure for Autonomous Drones

2020

Designed a project in the AI for social goods category of the Copernicus Hackathon 2020. The idea consists in the realization of a route system for autonomously guided drones, regulated by ML and satellite data from ESA.

Covid-Tracker

2020

Developed an Android app using Java for anonymous and secure tracking of COVID-19 infected people. The app allows the user to notify other people who may have encounter an infected person without violating privacy. The app was developed for the Hack@Home hackathon during COVID-19 first lockdown.

Map Reduce Implementation of KMeans algorithm

2020

Implemented the KMeans clustering algorithm using the MapReduce distributed programming framework. The result was two applications, one developed with Java and Hadoop and the other with Python and Spark.

Code: <https://github.com/davide-coccomini/KMeans-MapReduce>

BLOG ARTICLES

- Hebbian Learning: Neurons that fire together, wire together
URL: <https://davide-coccomini.medium.com/hebbian-learning-cells-that-fire-together-wire-together-cf197118c478>
Medium - 2023
- Transformers and Multimodal: The Same Key for all Data Types
URL: <https://medium.com/towards-data-science/transformers-and-multimodal-the-same-key-for-all-data-types-d990b79741a0>
Towards Data Science - 2022
- On Transformers, TimeSformers, and Attention: An exciting revolution from text to videos
URL: <https://medium.com/towards-data-science/transformers-an-exciting-revolution-from-text-to-videos-dc70a15e617b>
Towards Data Science - 2021
- How you can fight climate change with Machine Learning
URL: <https://medium.com/towards-data-science/should-machine-learning-experts-respond-to-climate-change-call-to-action-1ffeb4ba008b>
Towards Data Science - 2021
- Is attention what you really need in Transformers?
URL: <https://medium.com/towards-data-science/is-attention-what-you-really-need-in-transformers-6c161c2fca83>
Towards Data Science - 2021
- The Creative Side of Vision Transformers
URL: <https://medium.com/towards-data-science/the-creative-side-of-vision-transformers-e3efa7c4b859>
Towards Data Science - 2021
- How an AI Imagine the Universe
URL: <https://medium.com/towards-data-science/how-does-an-ai-imagine-the-universe-d1d01139b50a>
Towards Data Science - 2021
- Self-Supervised Learning in Vision Transformers
URL: <https://medium.com/towards-data-science/self-supervised-learning-in-vision-transformers-30ff9be928c>
Towards Data Science - 2021
- Vision Transformers or Convolutional Neural Networks? Both!
URL: <https://medium.com/towards-data-science/vision-transformers-or-convolutional-neural-networks-both-de1a2c3c62e4>
Towards Data Science - 2021

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