

Course Proposal

Artificial Intelligence and Sustainability

Teacher(s)

Allegra De Filippo (<https://www.unibo.it/sitoweb/allegra.defilippo/en>)

Cataldo Musto (<https://swap.di.uniba.it/members/musto.cataldo/>)

Course description (min 150, max 300 words)

The interplay between Artificial Intelligence (AI) and sustainability can be explored from two complementary perspectives: (i) AI for Sustainability, which addresses how AI algorithms can actively contribute to achieving the Sustainable Development Goals (SDGs), and (ii) Sustainability of AI, which emphasizes the development and deployment of AI systems aligned with principles of environmental, economic, and social sustainability.

This course aims to provide an in-depth understanding of both perspectives. First, it will introduce the concept of AI for Sustainability, offering an overview of the SDGs and discussing the role of AI in addressing key challenges and risks associated with the three core pillars of sustainability: society, economy, and environment. Subsequently, the course will focus on the Sustainability of AI, delving into the full lifecycle of AI systems and how to develop models that minimize environmental impact, ensure economic viability, ethical and social values.

Through interactive lectures, case studies, and practical examples, such as tools for monitoring the carbon footprint and computational demands of AI systems, with a focus on Recommender Systems. Students will acquire the tools to critically analyze AI applications from a sustainable standpoint.

Course period

June-July 2026

SSD

INF/01, ING-INF/05

Course References (optional)

[1] Fund, Sdg. "Sustainable development goals." *Available at this link: <https://www.un.org/sustainabledevelopment/inequality>* (2015).

[2] Van Wynsberghe, Aimee. "Sustainable AI: AI for sustainability and the sustainability of AI." *AI and Ethics* 1.3 (2021): 213-218.

[3] Spillo, Giuseppe, et al. "Towards green recommender systems: Investigating the impact of data reduction on carbon footprint and algorithm performances." *Proceedings of the 18th ACM Conference on Recommender Systems*. 2024.

Credits and Hours

2 credits of lectures for a total of 16 hours.

Allegra De Filippo 12 hours and Cataldo Musto 4 hours.

Exam Modality

Students who require an exam will complete a final project and submit a report that critically analyzes an AI-based solution related to both "AI for Sustainability" and "Sustainability of AI." The final report submission deadline will be 10–15 days after the last lecture.

Teacher(s) CV

Allegra De Filippo

Allegra De Filippo is an assistant professor at the Department of Computer Science and Engineering, University of Bologna, Italy. She received her Ph.D in Computer Science and Engineering at the University of Bologna (2020). Her doctoral thesis was identified as being of exceptional quality during the evaluation process of the EurAI 2021 PhD Thesis Award. Allegra De Filippo received the proposal to publish her thesis in the "Frontiers in Artificial Intelligence and Applications" (FAIA) book series, which has a sub-series, "Dissertation in AI" for PhD dissertations considered to be of outstanding quality.

Her research focuses on decision support systems, stochastic optimization, and methods for integrated offline/online optimization under uncertainty in complex systems, focusing on energy efficiency. Her recent research activities focus on the environmental sustainability of AI, with particular attention to recommender systems. In 2023 and 2024, she authored two contributions accepted at ACM RECSYS 2024 (International Conference on Recommender Systems), discussing the interplay between recommender systems and sustainability. She has published papers at top-tier international conferences and journals in artificial intelligence (IJCAI and JAIR) and collaborated with research groups, universities, and companies in AI and sustainability.

She is the track chair of the IJCAI 2025 AI, Arts & Creativity special track. She is an editorial board member of the journal ACM Computing Survey and has served in organizational and scientific roles for several events.

She also organized different workshops, including RecSoGood 2024, the First International Workshop on Recommender Systems for Sustainability and Social Good, co-located with ACM RecSys 2024, and three editions of the Artificial Intelligence and Creativity (CREAI) workshop at the International Conference of the Italian Association for Artificial Intelligence and ECAI 2024. She is the editor of an upcoming volume on "Recommender Systems for Sustainability and Social Good" (Springer, CCIS Series) and organizer of the tutorial on "Human-Centered and Sustainable Recommender Systems" at the ACM UMAP '25 conference.

Cataldo Musto

Cataldo Musto is an Associate Professor at the University of Bari, Department of Computer Science. His research lies at the intersection of Natural Language Processing (NLP), Large Language Models (LLMs), semantic content representation, and their application in knowledge-aware recommender systems and AI algorithms.

He has authored over 90 scientific publications and is one of the authors of the textbook "Semantics in Adaptive and Personalized Systems: Methods, Tools, and Applications"

(Springer). He also authored "L'Intelligenza Artificiale per lo Sviluppo Sostenibile", in collaboration with the Italian Association for Artificial Intelligence.

Prof. Musto has contributed extensively to the AI and recommender systems community through conference organization roles. He has served in various chairs at ACM UMAP and ACM RecSys conferences: Student Volunteers Chair (2019), Social Chair (2020), Poster and Demo Chair (2022), Doctoral Symposium Chair (2023), Workshops Chair (2024), and will be Program Chair of ACM UMAP in 2025.

Since 2016, he has delivered tutorials at UMAP and ESWC on semantic-aware recommender systems. Since 2019, he has also organized workshops such as Explainable User Modeling (ExUM), Knowledge-aware Recommender Systems (KARS), and Explainable Artificial Intelligence (XAI).

Teacher(s) Main Publications

List 10 main publications in the last 15 years for each

ALLEGRA DE FILIPPO

- Allegra De Filippo, Emanuele Di Giacomo, Andrea Borghesi: Machine learning approaches to predict the execution time of the meteorological simulation software COSMO. *J. Intell. Inf. Syst.* 63(1): 85-109 (2025)
- Lorenzo Stacchio, Silvia Garzarella, Pasquale Cascarano, Allegra De Filippo, Elena Cervellati, Gustavo Marfia: DanXe: An extended artificial intelligence framework to analyze and promote dance heritage. *Digit. Appl. Archaeol. Cult. Heritage* 33: 00343 (2024)
- Mattia Silvestri, Allegra De Filippo, Michele Lombardi, Michela Milano: UNIFY: A unified policy designing framework for solving integrated Constrained Optimization and Machine Learning problems. *Knowl. Based Syst.* 303: 112383 (2024)
- Allegra De Filippo, Michela Milano: Large Language Models for Human-AI Co-Creation of Robotic Dance Performances. *IJCAI 2024*: 7627-7635
- Giuseppe Spillo, Allegra De Filippo, Cataldo Musto, Michela Milano, Giovanni Semeraro: Towards Green Recommender Systems: Investigating the Impact of Data Reduction on Carbon Footprint and Algorithm Performances. *RecSys 2024*: 866-871
- Giuseppe Spillo, Allegra De Filippo, Cataldo Musto, Michela Milano, Giovanni Semeraro: Towards Sustainability-aware Recommender Systems: Analyzing the Trade-off Between Algorithms Performance and Carbon Footprint. *RecSys 2023*: 856-862
- Allegra De Filippo, Luca Giuliani, Eleonora Mancini, Andrea Borghesi, Paola Mello, Michela Milano: Towards Symbiotic Creativity: A Methodological Approach to Compare Human and AI Robotic Dance Creations. *IJCAI 2023*: 5806-5814
- Allegra De Filippo, Andrea Borghesi, Andrea Boscarino, Michela Milano: HADA: An automated tool for hardware dimensioning of AI applications. *Knowl. Based Syst.* 251: 109199 (2022)
- Mattia Silvestri, Allegra De Filippo, Federico Ruggeri, Michele Lombardi: Hybrid Offline/Online Optimization for Energy Management via Reinforcement Learning. *CPAIOR 2022*: 358-373
- Allegra De Filippo, Michele Lombardi, Michela Milano: Integrated Offline and Online Decision Making under Uncertainty. *J. Artif. Intell. Res.* 70: 77-117 (2021)

CATALDO MUSTO

- Alain D. Starke, Cataldo Musto, Amon Rapp, Giovanni Semeraro, Christoph Trattner: "Tell Me Why": using natural language justifications in a recipe recommender system

to support healthier food choices. *User Model. User Adapt. Interact.* 34(2): 407-440 (2024)

- Giuseppe Spillo, Cataldo Musto, Marco de Gemmis, Pasquale Lops, Giovanni Semeraro: Recommender systems based on neuro-symbolic knowledge graph embeddings encoding first-order logic rules. *User Model. User Adapt. Interact.* 34(5): 2039-2083 (2024)
- Giuseppe Spillo, Allegra De Filippo, Cataldo Musto, Michela Milano, Giovanni Semeraro: Towards Green Recommender Systems: Investigating the Impact of Data Reduction on Carbon Footprint and Algorithm Performances. *RecSys 2024*: 866-871
- Alessandro Petruzzelli, Cataldo Musto, Michele Di Carlo, Giovanni Tempesta, Giovanni Semeraro: Recommending Healthy and Sustainable Meals exploiting Food Retrieval and Large Language Models. *RecSys 2024*: 1057-1061
- Giuseppe Spillo, Allegra De Filippo, Cataldo Musto, Michela Milano, Giovanni Semeraro: Towards Sustainability-aware Recommender Systems: Analyzing the Trade-off Between Algorithms Performance and Carbon Footprint. *RecSys 2023*: 856-862
- Cataldo Musto, Pasquale Lops, Marco de Gemmis, Giovanni Semeraro: Context-aware graph-based recommendations exploiting Personalized PageRank. *Knowl. Based Syst.* 216: 106806 (2021)
- Cataldo Musto, Fedelucio Narducci, Marco Polignano, Marco de Gemmis, Pasquale Lops, Giovanni Semeraro: MyrrorBot: A Digital Assistant Based on Holistic User Models for Personalized Access to Online Services. *ACM Trans. Inf. Syst.* 39(4): 46:1-46:34 (2021)
- Cataldo Musto, Marco de Gemmis, Pasquale Lops, Giovanni Semeraro: Generating post hoc review-based natural language justifications for recommender systems. *User Model. User Adapt. Interact.* 31(3): 629-673 (2021)
- Vittorio Lingiardi, Nicola Carone, Giovanni Semeraro, Cataldo Musto, Marilisa D'amico, Silvia Brena: Mapping Twitter hate speech towards social and sexual minorities: a lexicon-based approach to semantic content analysis. *Behav. Inf. Technol.* 39(7): 711-721 (2020)
- Cataldo Musto, Marco Polignano, Giovanni Semeraro, Marco de Gemmis, Pasquale Lops: Myrror: a platform for holistic user modeling. *User Model. User Adapt. Interact.* 30(3): 477-511 (2020)