Preface of the 1st Workshop on Graphs Across AI: From Structural Reasoning to Foundation Models (GRAAI 2026)

Gianluca Bonifazi[1], Claudio Gallicchio[2], Barbara Hammer[3], Michele Marchetti[1] and Luca Virgili[1]

[1]Department of Information Engineering, Marche Polytechnic University, Italy
[2]Department of Computer Science, University of Pisa, Italy
[3]CITEC Cluster, Bielefeld University, Germany

Abstract

Graphs provide a flexible framework for representing relationships, dependencies, and structural patterns across Artificial Intelligence. Beyond Graph Neural Networks, graph-based representations support knowledge organization, reasoning, retrieval, interpretability, and the analysis of complex AI systems. The Graphs Across AI: From Structural Reasoning to Foundation Models (GRAAI 2026) workshop explores these perspectives, bringing together research on graph-based methods and their connections with emerging AI paradigms.

Keywords

Graph Representation Learning, Knowledge Graphs, Graph-Based Reasoning, Foundation Models, Retrieval-Augmented Generation

1. Introduction

Graphs provide a natural and flexible framework for representing relationships, dependencies, and structural patterns across a wide range of Artificial Intelligence (AI) problems. Their ability to explicitly capture interactions among entities makes them a common language for knowledge representation, reasoning, and learning. While Graph Neural Networks (GNNs) have established graph-based learning as a major research area, the role of graphs in modern AI extends well beyond this paradigm. Graphs underpin knowledge representation and reasoning, support structured retrieval and information integration, model interactions in complex systems, and provide useful abstractions for analyzing the internal organization of neural models.

At the same time, the emergence of foundation and generative models is opening new opportunities for combining graph-based representations with large-scale neural architectures. Graph structures can provide explicit relational knowledge and support more structured forms of retrieval and reasoning. These developments motivate a broader perspective in which graphs are not associated with a single learning paradigm, but rather serve as a common representational framework across different areas of AI.

Motivated by these developments, the first Workshop on *Graphs Across AI: From Structural Reasoning to Foundation Models* (GRAAI 2026) was organized in conjunction with the IEEE World Congress on Computational Intelligence (WCCI 2026) in Maastricht, The Netherlands. The workshop brought together researchers investigating the role of graphs across AI, with the goal of strengthening the connections between graph-based learning, knowledge representation and reasoning, retrieval, interpretability, and emerging foundation-model paradigms.

The workshop welcomed theoretical, methodological, and application-oriented contributions addressing graph-based approaches across AI. Topics included graph structures in neural architectures,

1st Workshop on Graphs Across AI: From Structural Reasoning to Foundation Models, held in conjunction with the IEEE World Congress on Computational Intelligence (WCCI 2026), June 21–26, 2026, Maastricht, The Netherlands
g.bonifazi@univpm.it (G. Bonifazi); claudio.gallicchio@unipi.it (C. Gallicchio); bhammer@techfak.uni-bielefeld.de (B. Hammer); michele.marchetti@univpm.it (M. Marchetti); luca.virgili@univpm.it (L. Virgili)
0000-0002-1947-8667 (G. Bonifazi); 0000-0002-6692-2564 (C. Gallicchio); 0000-0002-0935-5591 (B. Hammer); 0000-0003-3692-3600 (M. Marchetti); 0000-0003-1509-783X (L. Virgili)
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CEUR Workshop Proceedings ceur-ws.org ISSN 1613-0073
published 2026-11-08

CEUR-WS.org/Vol-4319/preface.pdf

graph-based representation learning, knowledge graphs and reasoning, graph-driven interpretability, graph-based Retrieval-Augmented Generation (RAG), trustworthy retrieval, temporal and dynamic graphs, multi-agent and multimodal systems, and theoretical foundations connecting graph theory with emerging AI paradigms.

2. Workshop Statistics

The first edition of GRAAI received contributions from authors across 10 countries. A total of 14 papers were submitted to the workshop. The submissions underwent a peer-review process in which 31 reviews were completed by the members of the Program Committee. Based on this evaluation, 6 papers were accepted for presentation and inclusion in the proceedings, resulting in an acceptance rate of 43%.

3. Workshop Program

The workshop program combined presentations of the accepted contributions with an invited talk and opportunities for discussion among participants. The invited talk, entitled *Designing Graph Neural Networks as Dynamical Systems*, was delivered by Prof. Davide Bacciu, Full Professor at the University of Pisa.

The contributed presentations reflected the broad scope of GRAAI and highlighted several complementary directions in which graph structures are being used across modern AI. A significant part of the program focused on the integration of knowledge graphs with language models, including graph-based retrieval, structured grounding, and multi-hop reasoning. These contributions explored how relational information can be preserved during retrieval and used to support more coherent and efficient reasoning over structured knowledge.

Other contributions investigated graphs as a tool for modeling and understanding learning systems themselves. This included theoretical perspectives connecting the geometry of neural networks with graph representations of their activation regions, as well as structural analyses of sparse neural networks aimed at characterizing their evolution during training. Graph-based learning was also explored for dynamic networked systems, where relational dependencies were combined with probabilistic forecasting and uncertainty calibration.

Finally, the workshop featured applications of graph-based AI to cybersecurity, ranging from the use of structured cybersecurity knowledge to ground language models to the modeling of heterogeneous interactions among users, devices, network contexts, and resources for security-related decision making. Overall, the contributed presentations illustrated the multiple roles that graphs can play across AI: as representations of knowledge, substrates for retrieval and reasoning, models of relational environments, and analytical tools for studying the structure and behavior of learning systems.

4. Program Committee

We would like to thank the members of the GRAAI 2026 Program Committee for their valuable contribution to the review process:

- Alessia Amelio, Università G. d'Annunzio
- Inaam Ashraf, University of Bielefeld
- Christopher Buratti, Marche Polytechnic University
- Francesco Cauteruccio, University of Salerno
- Gaetano Cimino, University of British Columbia
- Stefano Cirillo, University of Salerno
- Alessio Gravina, University of Pisa
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- Vincenzo Pasquadibisceglie, University of Bari
- Eliana Pastor, Polytechnic University of Turin
- Giandomenico Solimando, University of Salerno
- Serena Tardelli, IIT CNR
- Matteo Tolloso, University of Pisa
- Davide Traini, University of Modena and Reggio Emilia
- Domenico Ursino, Marche Polytechnic University
- Daniele Zambon, The Swiss AI Lab IDSIA & USI

Acknowledgments

We would like to thank all authors for submitting their work and contributing to the workshop, the members of the Program Committee for their careful and constructive reviews, Prof. Davide Bacciu for his invited talk, and all participants for contributing to the discussions. We also thank the organizers of WCCI 2026 for hosting GRAAI and supporting its organization.

Declaration on Generative AI

During the preparation of this work, the author used ChatGPT in order to: grammar and spelling check, paraphrase and reword. After using this tool, the author reviewed and edited the content as needed and takes full responsibility for the publication's content.