PhD Giacomo Balloccu

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WORK EXPERIENCE

META | Research Scientist E4 — London, UK | Nov 2024 – Present

AMAZON ADS | Applied Scientist II Intern — Edinburgh, UK | May 2024 – August 2024

- Constructed an artificial datasets through prompt engineering on Anthropic Claude, utilizing chain-of-thought and multi-agent models for context-to-keyword retrieval.
- Fine-tuned a retrieval Language Model with performance signals to develop a click-through rate-optimized keyword Recommender System for contextual targeting advertisers.

AMAZON ADS | Applied Scientist II Intern — Edinburgh, UK | November 2022 – March 2023

- Actively collaborated with engineering, product teams, and other scientists on Contextual Targeting products.
- Developed a multilingual Natural Language Inference methodology for context-to-category classification for sourcing adlines in offsite contexts.

UNIVERSITY OF CAGLIARI | Teaching Assistant — Cagliari, IT | March 2022 – Sept 2024

- Crafted and taught Python notebooks over three semesters for "Algorithms and Data Structures" coursework, encompassing algorithm implementation, theoretical concepts, and problem-solving exercises.

RELEVANT PUBLICATIONS

[1] Afreen, N., **Balloccu, G.**, Boratto, L., Fenu, G., Malloci, F. M., Marras, M., & Martis, A. G. (2024). *EDGE: A conversational interface driven by large language models for educational knowledge graphs exploration.* In Proceedings of the **33rd ACM International Conference on Information and Knowledge Management** (pp. 5159-5163). [Paper] [Github]

[2] **Balloccu, G.**, Boratto, L., Fenu, G., Marras, M., & Soccol, A. (2024, October). *KGGLM: A Generative Language Model for Generalizable Knowledge Graph Representation Learning in Recommendation.* In Proceedings of the **18th ACM Conference on Recommender Systems** (pp. 1079-1084). [Paper] [Github]

[3] **Balloccu, G.**, Boratto, L., Cancedda, C., Fenu, G., & Marras, M. (2023). *Faithful Path Language Modelling for Explainable Recommendation over Knowledge Graph.* **arXiv preprint** arXiv:2310.16452. [Paper] [Github]

[4] Afreen, N., **Balloccu, G.**, Boratto, L., Fenu, G., Malloci, F. M., Marras, M., & Martis, A. G. (2024, June). *Learner-centered Ontology for Explainable Educational Recommendation.* In Adjunct Proceedings of the **32nd ACM Conference on User Modeling, Adaptation and Personalization** (pp. 567-575). [Paper] [Github]

[5] **Balloccu, G.**, Boratto, L., Fenu, G., Malloci, F. M., & Marras, M. (2024, March). *Explainable Recommender Systems with Knowledge Graphs and Language Models.* In **European Conference on Information Retrieval** (pp. 352-357). Cham: Springer Nature Switzerland. [Paper] [Github]

[6] **Balloccu, G.**, Boratto, L., Fenu, G., & Marras, M. (2023). *Reinforcement recommendation reasoning through knowledge graphs for explanation path quality*. **Elsevier, Knowledge-Based Systems**, 260, 110098. [Paper] [Github]

[7] **Balloccu, G.**, Boratto, L., Cancedda, C., Fenu, G., & Marras, M. (2023, March). *Knowledge is power, understanding is impact: Utility and beyond goals, explanation quality, and fairness in path reasoning recommendation.* In **European Conference on Information Retrieval** (pp. 3-19). Cham: Springer Nature Switzerland. [Paper] [Github]

[8] **Balloccu, G.**, Boratto, L., Fenu, G., & Marras, M. (2022, September). *Hands on explainable recommender systems with knowledge graphs.* In Proceedings of the **16th ACM Conference on Recommender Systems**. [Paper] [Github]

[9] **Balloccu, G.**, Boratto, L., Fenu, G., & Marras, M. (2022, July). *Post processing recommender systems with knowledge graphs for recency, popularity, and diversity of explanations.* In Proceedings of the **45th International ACM SIGIR Conference on Research and Development in Information Retrieval** (pp. 646-656). [Paper] [Github]

RESEARCH PROJECTS

PATH LANGUAGE MODELLING FOR EXPLAINABLE RECOMMENDATION

- Obtained 35% improvement in recommendation utility (NDCG) and significant gains in beyond-accuracy metrics by introducing a novel methodology [2] that combines path generation with language models, using sampled paths for graph representation learning.

- Developed a constraint-based decoding approach [3], leveraging the knowledge graph during decoding to prevent model hallucinations and ensure faithful, explainable recommendations.

REPRODUCIBILITY OF KNOWLEDGE AWARE MODELS

- Led a reproducibility study [7] to validate that knowledge-aware and explainable methods are executable by practitioners, standardizing benchmarks across protocols.
- Developed a comprehensive evaluation protocol assessing beyond-accuracy metrics, which was applied to rigorously test 10 models. This protocol improved code quality and scalability, and supported the creation of an open-source, modular library for unbiased evaluations.

TUTORIAL SERIES ON EXPLAINABLE RECOMMENDER SYSTEMS

- Designed and conducted a 4-hour tutorial on Explainable Knowledge-Aware Recommender Systems at RecSys22 [8], engaging 300+ attendees across in-person and online and over 45 Github stars.
- Presented an updated 3-hour version at ECIR24 [5], incorporating basics of Transformers and Language Models and their application to Path Reasoning, addressing evolving industry and academic needs.

EXPLANATION QUALITY IN REINFORCEMENT LEARNING PATH REASONING

- Conducted research on explainable recommender models, identifying limitations in their explanation quality and introducing new metrics for textual explanations including recency, serendipity, and diversity.
- Developed and optimized a graph-based Reinforcement Learning Recommender System, implementing post-processing [9] and in-processing methods [6] to significantly improve explanation quality with minimal impact on recommendation accuracy.
- Empirically assessed the improved models across multiple datasets (Movies, Music, Clothing, eCommerce), achieving over a 100% increase in explanation quality and a 3% improvement in recommendation utility against multiple baselines.

RESEARCH MANAGEMENT

EXPLAINABLE RECOMMENDATION IN EDUCATIONAL DOMAIN

- Contributed to the EDUC project by providing supervision on the data modeling and student mentoring in the development of a suit of datasets for the education domain [3] and a RAG methodology for coursework retrieval [1].

HEALTHY AND SUSTAINABLE FOOD RECOMMENDATION CHATBOT

- Authored the methodology section of a successful funding proposal ($200k) as part of a multidisciplinary team from three faculties, focusing on a food recommendation chatbot that promotes healthiness.
- Collaborated with cross-functional teams to align chatbot development with broader project goals. Supervised the data modeling process, ensuring the seamless integration of a dietary data knowledge graph with user preferences to enhance the recommendation system.

EDUCATION

PhD. Artificial Intelligence (AI) and Recommender Systems Cagliari, IT | Oct. 2021 - Feb. 2025
University of Cagliari
Research Areas: Recommender Systems, End-User Explainability, Natural Language Processing

M.S in Computer Science and Artificial Intelligence (AI) Cagliari, IT | Oct. 2019 - Sept. 2021
University of Cagliari, Summa Cum Laude

B.S. in Computer Science Cagliari, IT | Oct. 2016 - Sept. 2019
University of Cagliari

SKILLS

- **Tools:** Python, C++, Java, SQL, PyTorch, Pandas, Huggingface Transformers, Spark, Git, AWS, Glue
- **Technical Skills:** Machine Learning, Deep Learning, Natural Language Processing, Graph Learning, Reinforcement Learning, Data Analytics, Data Visualization, Algorithms, Advertisement
- **Soft Skills:** Writting and Narratives, Critical Thinking, Effective Communication, Leadership
- **Conference Committees:** ACM RecSys24, ECIR24, CIKM24, ECIR23, AMLC 2024, Local Chair UMAP24
- **Volunteer and Leadership:** LeadTheFuture Mentor 2022 / 2024, HuggingFace Student Ambassador 2022
- **Awards:** Outstanding Reviewer at ECIR23, SIGIR22 Student Travel Grant