Melika Ayoughi

PostDoc | Machine Learning

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I am finalizing my PhD at the intersection of **Vision Foundation Models and Knowledge Graphs**. I have experience in working with graphs, non-Euclidean manifolds (e.g., Hyperbolic space) and self-supervised representation learning. My research addresses challenges in **low-resource**, biased data—a critical constraint in real-world applications like AI for music generation— by using external or internal priors.

I am driven by the challenge of scaling AI to tackle complex **real-world** problems that conventional methods struggle to solve. My expertise in representation learning, multimodal and hierarchical data, self-supervised foundation models, and label-efficient methods positions me to develop robust, interpretable AI systems for complex domains.

Professional Experience

08.2025-04.2026 — PostDoc | Music Cognition Group, Institute for Logic, Language and Computation, Amsterdam
- AI music attribution: I will be developing cutting-edge models that formalize the connection between musical works in training data, generative music models, and their outputs with the goal of fair remuneration of artists.

08.2023-12.2023 — Research Internship | Apple Machine Learning Research, Cupertino, USA
- Self-Supervised Relative Position Reasoning: Developed transformer pretraining using relative part transformations, solving off-grid reconstruction puzzles to learn compositional representations.

10.2019-07.2020 — M.Sc. Thesis Research Internship | TomTom, Amsterdam, The Netherlands
- Multi-Scale Gambler for Long-tailed Object Detection: Tackled class imbalance in long-tailed distributions through an innovative multi-scale detection framework.
  `Pytorch`

06.2019-08.2019 — Deep Learning Internship | Dexter Energy Services B.V., Amsterdam, The Netherlands
- Deep Learning for Weather Nowcasting: Implemented ConvGRU-based models on EUMETSAT satellite data to predict short-term cloud dynamics, enabling energy imbalance forecasts.
  `Pytorch, Google Cloud Services`

07.2016-09.2016 — Internship | Computational Social Science Lab, ETH Zürich, Zürich, Switzerland
- Developed a publish-subscriber system for the existing "Dynamic Intelligent Aggregation Service (DIAS) " intended to aggregate and disseminate various sensor data across large number of nodes in a secure way.
  `Java`

Education

10.2020-05.2025 — PhD in Machine Learning | University of Amsterdam
- Thesis: External & Internal Semantics for Multimodal Understanding
- Supervisors: Prof. Dr. Paul Groth (INDE Lab), Dr. Pascal Mettes (VIS Lab)

09.2018-08.2020 — M.Sc. in Artificial Intelligence | University of Amsterdam
- GPA: 8/10
- Thesis: Multi-scale Gambler for Long-tailed Object Detection

09.2013-06.2018 — B.Sc. in Computer Science: Information Technology track | University of Tehran
- 1st rank, GPA: 8.75/10
- Received three Honors Scholarship awards.
- Thesis: Sentiment Analysis on customer ratings of the biggest Iranian e-commerce company, Digikala
  `Python, Apache Spark, Scala`

09.2006-06.2013 — Mathematics & Physics Highschool Diploma | National Organization for Development of Exceptional Talents (NODET)

Selected Publications

Ayoughi, M., Van Spengler, M., Mettes, P., Groth, P. (2025). **Designing Hierarchies for Optimal Hyperbolic Embedding.** European Semantic Web Conference. **Best research paper nominee.**

https://doi.org/10.1007/978-3-031-94575-5_20 GitHub

Conducted a comprehensive study on how the structural properties of ontologies affect the quality of hyperbolic embeddings for hierarchical learning. Demonstrated through extensive experiments that wide hierarchies with single inheritance consistently yield better embedding performance, regardless of hierarchy size or imbalance. The findings provide practical guidelines for ontology and knowledge graph designers to optimize downstream hyperbolic learning tasks.

Ayoughi, M., Atigh, MG., Derakhshani, MM., Mettes, P., Groth, P. (2025). **Continual Hyperbolic Learning of Instances and Classes.** Transactions on Machine Learning Research. Under revision

arxiv GitHub

Developed HyperCLIC, a continual learning algorithm designed to simultaneously learn both instances and classes, addressing a key challenge in real-world applications like robotics and autonomous systems. The method leverages the natural hierarchical structure between instances and classes by embedding them in hyperbolic space, which is well-suited for representing hierarchical data. HyperCLIC integrates hyperbolic classification and distillation objectives to support continual learning of hierarchical relationships over time. Introduced novel continual hierarchical metrics to evaluate performance across multiple levels of granularity. Demonstrated superior hierarchical generalization on dynamic, real-world data.

Ayoughi, M., Abnar, S., Huang, C., Sandino, C., Lala, S., Dhekane, EG., Busbridge, D., Zhai, S., Thilak, V., Susskind, J., M., Mettes, P., Groth, P., Goh, H. (2024). **How PARTs assemble into wholes: Learning the relative composition of images.** Computer Vision and Image Understanding Journal. Under Revision

http://dx.doi.org/10.2139/ssrn.5257874 GitHub

Proposed PART, a self-supervised learning framework that captures rich spatial relationships by learning continuous relative transformations between random input patches, rather than relying on fixed grid structures. This off-grid approach enables more nuanced spatial understanding, leading to superior performance on tasks like object detection and time series prediction. PART surpasses established methods such as MAE and DropPos, with minimal hyperparameter tuning, and retains strong performance on standard classification benchmarks, demonstrating its versatility across domains.

Ayoughi, M., Mettes, P., Groth, P. (2023). **Self-contained entity discovery from captioned videos.** ACM Transactions on Multimedia Computing, Communications and Applications, 19(5s), 1-21.

https://doi.org/10.1145/3583138 GitHub

Introduced the task of self-contained visual named entity (faces, objects, scenes) discovery in videos, without manual labels or external databases. Proposed a three-stage method: (i) creating a bipartite entity-name graphs from frame-caption pairs, (ii) finding visual entity agreements, and (iii) refining the entity assignment through entity-level prototype construction. To tackle this new problem, we built two new benchmarks SC-Friends and SC-BBT, where we achieve near-supervised accuracy using only the multimodal information present in videos.

Teaching & Supervision

- **Supervising** Diego Canez, "Self-Supervised Learning with Generalized Patch-Level Relative Transformations" (M.Sc. AI thesis, University of Amsterdam, 2025).
- **Supervised** Thomas Wiggers, "Exemplar-free Continual Representation Learning with Symmetric Distillation" (M.Sc. AI thesis, University of Amsterdam, 2024) with Tejaswi Kasarla.
- **Supervised** Vadim Porvatov, "Revising Deep Learning Methods for Video-based Multimodal Scene Graph Generation" (M.Sc. DS thesis, University of Amsterdam, 2023).
- **Supervised** Martijn van Oers, "Handwritten Symbol Recognition using Generated Image Data" (B.Sc. AI thesis, University of Amsterdam, 2022).
- **Teaching assistant** at the **Oxford Machine Learning Summer School** in the UK in **2024** about **Hyperbolic Deep Learning** in the Representation Learning track.
- **Teaching assistant** of the **Applied Machine Learning** course at the UvA in **2020, 2021, and 2022**. Pioneered the course's first fully online poster session for final project presentations. Led math tutorials, setup an automatic grading system for weekly projects, corrected exams, and supervised student projects in the master's-level course.
- **Teaching assistant** of the **Machine Learning 1** course at the UvA in **2019**. Corrected weekly assignments and exams.
- **Teaching assistant** of the **Computer networks** course at the UT in **2017**. Designed and corrected assignments, and exams.
- **Teaching assistant** of the **Algorithm Design** course at the UT in **2017**. Designed and corrected assignments, and exams.
- **Teaching assistant** of the **Artificial Intelligence** course at the UT in **2016**. Designed and corrected assignments, projects and exam questions.
- **Teaching assistant** of the **Data Structures** course at the UT in **2016**. Designed and corrected assignments, projects and exams.
- **Teaching assistant** of the **Introduction to Computing Systems and Programming** course at the UT in **Fall 2015**. De-

signed and corrected assignments, and exams.
- **Teaching assistant** of the **Discrete Mathematics** course at the UT in **2014-2015** for three consecutive semesters. Designed and corrected assignments, and exam questions.

Talks and poster Presentations

- Oral presentation at the **22nd European Semantic Web Conference**, June 2025, Portorož, Slowenia. ESWC25
- Poster presentation at **The Netherlands Conference on Computer Vision**, May 2025, Utrecht, The Netherlands. NCCV25
- Poster presentation at the **NeurIPS Fest**, November 2024, Amsterdam, The Netherlands. NeurIPS Fest24
- Poster presentation on *"Hyperbolic continual learning of instances and classes"* at the **Instance-level recognition workshop at ECCV2024**, October 2024, Milan, Italy. ILR2024
- Poster presentation on *"Self-supervised Pretraining with Pairwise Relative Translations"* at the **Self Supervised Learning: What is Next? workshop at ECCV2024**, October 2024, Milan, Italy. SSL2024
- Poster presentation at the **Deep Learning Extravaganza**, June 2024, Amsterdam, The Netherlands. DLE24
- Poster presentation at **The Netherlands Conference on Computer Vision**, May 2024, Den Bosch, The Netherlands. NCCV24
- Oral presentation at the **scientific meeting open to all IvI members** about the IvI-collaboration PhDs and their projects at the University of Amsterdam, February 2023, Amsterdam, The Netherlands.
- Poster presentation on *"Self-Contained Entity Discovery from Captioned Videos"* at the **17th Women in Machine Learning Workshop at NeurIPS 2022**, November 2022, New Orleans, USA. WiML2022
- Poster presentation at the **NeurIPS Fest**, November 2022, Amsterdam, The Netherlands. NeurIPS Fest22
- Poster presentation at the **Vision and Sports Summer School**, July 2022, Prague, Czechia. VS3 2022
- Poster presentation at **The Netherlands Conference on Computer Vision**, May 2022, Volendam, The Netherlands. NCCV22
- Oral presentation at the **AI Master's introduction event** for the future AI students at the University of Amsterdam, February 2020, Amsterdam, The Netherlands.

Volunteer Experience

- **Mentor at the UvA Inclusive AI** initiative from Oct. 2020 – Now. IAI
- **Board member of the UvA Inclusive AI** initiative from Oct. 2020 – July 2023. Organized events and workshops, financed students to attend conferences. IAI
- **Member of the ICX Team in AIESEC Iran** from Sep 2015 – June 2016. Designed and promoted projects, recruited volunteers and took part in leadership workshops within AIESEC. AIESEC
- **Interned at AIESEC Poland** from July 2015 – Sep. 2015. Conducted seminars for NGOs and museums with the purpose of raising cultural and social awareness among Polish people about Iran. Kielce, Poland. AIESEC

Scholarships and awards

- Best research paper nominee at the European Semantic Web Conference 2025.
- NeurIPS WiML travel grant, New Orleans, USA, 2022.
- Best bachelor thesis award, University of Tehran, 2017.
- University of Tehran Supporters Foundation Scholarship as the 1st ranked IT student, University of Tehran, 2016 – 2017.
- F.O.E.(Faculty of Engineering) award as the 1st ranked IT student of the year, University of Tehran, 2015–2016.