BARDH PRENKAJ
Postdoctoral Fellow, Chair of Responsible Data Science, Technical University of Munich

PERSONAL DETAILS

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PERSONAL STATEMENT

As an AI researcher with over 5 years of applied experience in generative AI, computer vision, deep learning, and anomaly detection, I specialize in explainability within critical domains. Holding a PhD in Computer Science, I have led impactful projects across both academic and industrial settings. My current research focuses on multimodal video understanding and action anticipation, aimed at improving how AI systems predict actions in complex scenarios. A core component of my work is the integration of large language models (LLMs) to make black-box decisions more interpretable for end-users. With a strong passion for bridging the gap between AI decision-making and human comprehension, particularly in high-stakes applications, I have developed robust software engineering skills. Proficient in Python, Pytorch, and Git for CI/CD pipelines, I am adept at delivering high quality, maintainable code. I am eager to apply my expertise in deep learning and explainability systems to contribute to groundbreaking research and development efforts.

RESEARCH EXPERIENCE

Postdoctoral Researcher, Technical University of Munich (04/2024 – ongoing)

- Researching on Machine Intelligence and Generative AI with a focus on the ARC challenge and generalizability with few training data.
- Worked on Multimodal Video Action Anticipation (ECCV'24) and Dynamic Graph Explainability (KDD'24).
- Launched GRETEL-2, an enhanced explainability framework with a focus on usability and extensibility. Demo paper in ECML-PKDD'24.

Postdoctoral Researcher, Sapienza University of Rome (10/2022 – 10/2024)

- Conducted research on Data Stream Anomaly Detection (TKDE'23, AIM'23) and Explainability on Graph Learning (CSUR'23, AAAI'24).
- Built GRETEL, the first graph counterfactual explainability modular framework, implemented using the Object-Oriented paradigm and the Factory Method design pattern. Demo paper in WSDM'23.
- Co-PI of a regional Italian project in AI for Healthcare (@HOME), specifically in anomaly detection in daily routines of neurodegenerative patients.
- Co-coordinated several projects on Motion Anomaly Detection with Diffusion Models (ICCV'23), LLM-based Visualization Recommender Systems (TVCG'23), Foundation Models for Times Series Anomalies (arXiv'24 submitted to JBHI).

Visiting Researcher, Technical University of Munich (06/2023 – 09/2023)

- Visiting period at the Responsible Data Science research group. Conducted research on explainability in dynamic data landscapes and graph learning. Workshop paper in DynXAI@ECML-PKDD'23.

Senior Research Fellow, Sapienza University of Rome *(part-time)* (12/2021 – 09/2022)

- Coordinated the research and implementation of innovative deep learning models to predict events in patient behavioral time series as a team lead in the regional Italian project E-Linus.
- Deployed bespoke per-patient models on Amazon Lightsail and exposed API end-points to facilitate interaction with other project components.

Visiting PhD Student, George Mason University (04/2021 – 06/2021)

- Visiting period at prof. Domeniconi's Data Mining lab and worked alongside Dr Sarvari on boosting-based anomaly detection models (PAKDD'21).

Student Research Assistant, Sapienza University of Rome (07/2017 – 10/2018)

- Extended the UCrawler framework to cope with crawling and scraping content of research articles and citation graphs on DBLP and SemanticScholar. During this period, I also completed my master's thesis.

OTHER EXPERIENCE

Software Engineer, PwC Rome, *(Digital Innovation Team)* (12/2021 – 06/2022)

- Focused on software prototyping and development activities. In particular, I optimized back-end services and developed highly maintainable and efficient API services.

Senior Software Consultant, E Software Solutions *(remote)* (09/2020 – 03/2021)

- Designed and maintained the CMS for electric vehicle leasing in the UK (https://gridserve.com/).

HONORS AND AWARDS

Subject Expert *("Cultore della Materia" Art. 42 del R.D. 04/06/1938, n.1269)* (12/2023)

- Award for highly-skilled researcher and technician on *Machine Learning* course in MSs Computer Science, Department of Information Engineering, Computer Science, and Statistics at Sapienza University of Rome.

Subject Expert *("Cultore della Materia" Art. 42 del R.D. 04/06/1938, n.1269)* (03/2023)

- Award for highly-skilled researcher and technician on *Deep Neural Networks* course in MS Computer Science, Department of Information Engineering, Computer Science, and Mathematics at University of L'Aquila.

Scholarship in AI & Computer Science (11/2021)

- Winner of the BS-S 6/2021 Open Competition published on September 15th 2021 (num: 1207, rep: 326, class: VII/1) on research project "000090 19 RS VELA RDI - RICERCA ATENEO 2019 - MEDI PROGETTI-VELARDI (Responsabile Scientifico, VELARDI P.)".

Scholarship in AI (05/2020)

- Winner of the Avvio alla Ricerca 2020 – Tipo I, prot. Num: AR120172A8B35EEA on the research project "*Personalized e-Learning Solutions to Improve the Efficacy of Learning Outcomes in Computer Science e-Courses"*. I devised an autonomous model to detect students prone to drop out of university in online computer science courses, and provide them with personalized feedback and learning pathways to support their academic journey.

Graduation Prize (03/2017)

- Winner of the Premio di Laurea distributed from LazioDiSU, Ente per il Diritto agli Studi Universitari nel Lazio num: 899, grade: 110/110. Sum: € 2,559.18

Merit Scholarship in Computer Science (09/2013 – 10/2018)

- Winner of the LazioDiSU Study Scholarship for B.Sc. (3 years) and M.Sc. (2 years). Yearly sum: € 5,118.36

EDUCATION

- **PhD in Computer Science, Sapienza University of Rome** (11/2018 – 02/2022)
  - Thesis: *"Latent Deep Sequential Learning of Behavioral Sequences"*
- **M.Sc. in Computer Science, Sapienza University of Rome** (01/2017 – 10/2018)
  - Thesis: *"Time-aware Topic Detection and Anomaly Classification in a Multi-layer Network"*
  - Graduated at top 1% of the class *(110/110 cum laude)*
- **B.Sc. in Computer Science, Sapienza University of Rome** (09/2013 – 12/2016)
  - Thesis: *"Automatic Detection of Online News Focus"*
  - Graduated at top 1% of the class *(110/110)*

FUNDED PROJECTS

@HOME (01/11/2023 – 31/05/2025) - AI and IoT based solutions for HOme care Monitoring of the Elderly - This work is funded under Riposizionamento Competitivo RSI Programma Regionale – FESR Lazio 2021-2027. CUP: F89J23001050007

- Funds: € 109, 563.72
- My role: **co-Principal Investigator (co-PI)**

E-Linus (01/11/2020 – 30/11/2021) - This work is supported by POR FESR Lazio 2014-2020, Avviso Pubblico "Emergenza Coronavirus e oltre".

- Funds: € 504,523.00
- My role: **Component (Team Lead)**

- Description: The project aims to identify social isolation, improve levels of home care, intervene with human interactions and AI devices, and foster emotional relationships with family members. It is an Active & Independent Living solution that operates through a network of noninvasive IoT devices, identifies symptomatic behaviors, and activates care-giving protocols and services via an App for professional and family caregivers.

PersonalSDP (13/10/2020 – 30/11/2021) - Personalized e-Learning Solutions to improve the Efficacy of Learning Outcomes in Computer Science e-Courses

- Funds: € 1,000.00
- My role: **Principal Investigator (PI)**
- Description: The main aim of this project is to predict dropout students from online computer science courses, and provide them with personalised feedback and learning pathways to support their academic journey. *This work was supported by Avvio alla Ricerca 2020 – Tipo 1, protocol number AR120172A8B35EEA*

SELECTED PUBLICATIONS

- Prenkaj, Villaizán-Vallelado, Leemann,, Kasneci. Unifying Evolution, Explanation, and Discernment: A Generative Approach for Dynamic Graph Counterfactuals. In Proceedings of the 30th ACM SIGKDD Conference on Knowledge Discovery and Data Mining 2024 (KDD'24) Aug 25 (pp. 2420-2431). Rank: **A***
- Prado-Romero*, Prenkaj*, Stilo. *Robust Stochastic Graph Generator for Counterfactual Explanations*. In the 38th Annual AAAI Conference on Artificial Intelligence (AAAI'24). 2024. Rank: **A***
- Prenkaj, Velardi. *Unsupervised Detection of Behavioural Drifts with Dynamic Clustering and Trajectory Analysis*. IEEE Transactions of Knowledge and Data Engineering, 2023. doi: 10.1109/TKDE.2023.3320184. Rank: **Q1**
- Prado-Romero, Prenkaj, Stilo, Giannotti. *A Survey on Graph Counterfactual Explanations: Definitions, Methods, Evaluation*. In ACM Computing Surveys (CSUR), Special Issue on Trustworthy AI, 2023. Rank: **Q1**
- Diko A, Avola D*, Prenkaj B*, Fontana F, Cinque L. Semantically Guided Representation Learning For Action Anticipation. arXiv preprint arXiv:2407.02309. 2024 Jul 2. (accepted in ECCV'24). Rank: **A***

SKILLS

Hard Skills

- **Languages**: Albanian (mother tongue), Italian (bilingual), English (full working proficiency), German (basic).
- **Professional Competences**: Algorithms, graph learning, counterfactual explainability, anomaly detection, time series, computer vision, LLMs, image processing, video processing, machine learning, deep learning, representation learning, action anticipation, action classification, transformers, convolutional neural networks, unit testing, CI/CD, debugging, prompting.
- **Programming Languages**: Python 3 (6+ years), Java (2+ year), SQL (1+ year).
- **Tools and Frameworks (Expert)**: PyTorch, HuggingFace api, NumPy, SciPy, Scikit-learn, Pandas, PlotLy, Docker, Bash, git, AWS.
- **Tools and Frameworks (Proficient)**: PyTorch-Lightning, Tensorflow, Keras, PlotLy, MySQL.
- **Operating System**: Debian-based Linux (Ubuntu, Mint).

Soft Skills

- Communication, teamwork, attention to detail, problem-solving, adaptability, time management, work ethic, perseverance, consistency, and persistence, team lead.