

Alessandro Leanza

AI Research Engineer

Generative AI • Multimodal Learning • Robot Learning • LLM/RAG Systems

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Profile

PhD candidate at the Dalle Molle Institute for Artificial Intelligence (IDSIA USI-SUPSI), developing **generative and multimodal AI systems for robotics**, from LLM/RAG-based reasoning to diffusion policies and perception-control pipelines. Hands-on experience deploying research on **real robotic and wearable platforms**, with Python, PyTorch, ROS 2, Docker, local foundation models, and GPU-accelerated machine learning.

Experience

PhD Candidate in Informatics – AI & Robotics, IDSIA, USI/SUPSI, Lugano, Switzerland *Feb 2025 – Present*

- Design and implement multimodal AI systems combining **foundation models, robot learning, computer vision, force sensing, and adaptive control** for embodied decision-making and human-robot interaction.
- Built LLM-based planning and RAG systems integrating **knowledge graphs, semantic retrieval, provenance, affordance reasoning, and safety-aware decision-making**, evaluated across proprietary and open foundation models.
- Develop diffusion-based and multimodal learning methods for **compliant robotic manipulation**, integrating vision, proprioception, force/torque feedback, simulation, and variable-admittance control.
- Deploy and evaluate research pipelines on **real robotic and wearable platforms**, including industrial manipulators, active exoskeletons, egocentric vision systems, gaze tracking, and force/torque sensors.
- Lead and contribute to peer-reviewed research, open-source implementations, benchmark design, and invited PhD-level teaching in generative AI and robotics.

Product Manager – AI & Microsoft 365 Copilot Training, SUPSI, Lugano, Switzerland *Sep 2026 – Present*

- Serve as product/course lead within a five-person stakeholder group designing a **30-hour, four-module enterprise AI training program** for SUPSI.
- Translate institutional requirements into learning architecture and practical workflows spanning **Microsoft 365 Copilot, Power Automate, Copilot Studio, grounded assistants, and agentic AI**, while accounting for licensing and responsible-AI constraints.

Selected Research & Technical Projects

ConceptBot – Knowledge-Grounded LLM Planning for Robotics

[GitHub](#) • [arXiv](#)

Python • LLMs • Knowledge Graphs • Retrieval • Robot Planning

- Developed a modular LLM planning framework integrating ConceptNet-based semantic retrieval, affordance reasoning, and risk-aware task decomposition.
- Achieved **87% planning-policy correctness on implicit tasks** versus 31% for SayCan, and **76.2% on risk-aware tasks** versus 15% for SayCan, within a 47-instruction symbolic planning benchmark.
- Integrated generated policies with PyBullet simulation and physical Franka manipulation.
- Accepted at *Biomimetic Intelligence and Robotics*.

Graph-Based RAG for Provenance-Aware Robot Planning

[GitHub](#)

Python • Neo4j • Qwen • RAG • Embeddings • Local LLMs

- Built a fully local graph-RAG pipeline that extracts schema-constrained knowledge into a persistent **Neo4j object-centric knowledge graph** with confidence, source metadata, and evidence-level provenance.
- Implemented reliability- and relevance-aware retrieval for local LLM planning; profiled **sub-40 ms scene-conditioned graph retrieval** and 20–30 ms warm KG updates in evaluated scenes.
- Accepted at *Decision Science Alliance International Summer Conference 2026*.

YOLO • VLMs • Gaze Tracking • Adaptive Control • HRI

- Developed a real-time perception–control architecture combining **egocentric YOLO perception**, **gaze-based task-object selection**, **asynchronous VLM payload estimation**, and **variable-admittance control**.
- Reduced payload-aware assistance-onset delay after grasp from **1.892 s** to **0.066 s** through gaze-conditioned perception.
- Evaluated the system with **15 participants**; preliminary EMG analysis showed **10–18% lower erector-spinae activation** during loaded lifting versus the no-exoskeleton condition.

Learning & Understanding Compliance Policies

PyTorch • Diffusion Policies • MuJoCo • Force Sensing • Compliant Manipulation

- Develop learned compliance policies for contact-rich manipulation, combining multimodal observations with predicted motion and variable-admittance parameters.
- Designed controlled MuJoCo experiments to identify **when learned policies rely on force sensing rather than visual or proprioceptive cues**, isolating hidden physical properties from modality availability and label-generation confounds.

Additional Research: spectral steering of frozen diffusion generators using local inverse geometry across vision, audio, robotics, and control; local evidence-grounded RAG for human-centered collaborative workcell design, including an offline benchmark and Dockerized local-LLM environment.

Technical Skills

Programming & Systems: Python, Linux, Git/GitHub, ROS 2, Docker, MATLAB, Unity, C#

Machine Learning: PyTorch, TensorFlow, diffusion models, diffusion policies, imitation learning, robomimic, multi-modal learning, learning from demonstrations

Generative AI: LLMs, VLMs, RAG, local model serving, foundation-model evaluation, OpenAI, Gemini, DeepSeek, Qwen, Llama, Ollama

Knowledge & Retrieval: Neo4j, LangChain, knowledge graphs, semantic retrieval, provenance-aware reasoning

Perception & Robotics: YOLO, computer vision, gaze tracking, force/torque sensing, sensor fusion, adaptive and compliant control, MuJoCo

Acceleration: CUDA, TensorRT

Platforms: Franka Panda, Doosan M0609, active low-back exoskeleton, Tobii Pro Glasses 3, WEART TouchDIVER G1, Meta Quest 2, BOTA force/torque sensors

Education

PhD Candidate in Informatics, IDSIA, USI/SUPSI, Lugano, Switzerland

Feb 2025 – Present

M.Sc. in Mechanical Engineering – Mechatronics and Robotics, Politecnico di Milano

Sep 2022 – Dec 2024

110/110 cum laude

B.Sc. in Mechanical Engineering, Politecnico di Milano

Sep 2019 – Sep 2022

105/110

Teaching & Academic Service

Teaching Assistant at USI for *Introduction to Fintech* and *Founder I*. Invited PhD lecturer at the University of Milano-Bicocca on foundation models and knowledge graphs in robotics and at Politecnico di Milano on diffusion policies for compliant robotics.

Reviewer for IEEE ICRA, IEEE/RSJ IROS, RCIM, UR, and ISWC; co-organizer of *Generative Physical AI for Robotics*, IEEE CASE 2025; Master's thesis mentoring.

Languages

Italian (native) • English (C1, TOEIC 950) • German (A2)