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photo.jpg

Alessandro Pedone
Curriculum Vitae

▸ PERSONAL DATA

Date of Birth	01/10/2002
Nationality	Italian
Place of Birth	Milan, Italy

▸ CURRENT POSITION

Politecnico di Milano	Pursuing Master's Degree in Mathematical Engineering, with a focus on Computational Science and Computational Learning

▸ AREAS OF INTEREST

Scientific Machine Learning

Numerical Analysis

Partial Differential Equations (PDEs)

Mathematical Analysis

▸ EDUCATION

2024 - Current	**Master's Degree in Mathematical Engineering, Politecnico di Milano**
2021 - 2024	**Bachelor's Degree in Mathematical Engineering, Politecnico di Milano**

Final grade: 110/110 cum laude

Thesis: The Cauchy-Kowalevski theorem and some of its consequences

Keywords: PDEs, characteristics method, analyticity/holomorphy, power series, method of majorants, Cauchy-Kowalevski, Holmgren and Cartan-Kähler theorems

Supervisor: Prof. Maurizio Grasselli

▸ EXPERIENCE

23/06/2025 - 27/06/2025	**Theorical Foundations of Machine Learning 2025**

Admitted (as a Master's student) to a highly selective PhD program organized by MaLGa (Machine Learning Genoa Center) at the University of Genoa, with an acceptance rate of approximately 10%, primarily comprising PhD candidates.

Topics:
- Statistical learning theory framework
- Kernel methods and neural networks
- Empirical risk minimization and regularization
- Reproducing kernel Hilbert spaces (RKHS)
- Optimization techniques: convex analysis, gradient methods, stochastic optimization, splitting methods, backpropagation
- Theoretical analysis: concentration inequalities, empirical process theory, spectral calculus, operator theory

▸ PROJECTS

04/2025 - Current	**Coupling CGA-DL-ROM with traditional solver for multiphysics problem**

Reference: 🔗

Objective: perform simulation of a simplified MEMS dynamics.

Dataset: 1000 meshes with the corresponding solutions of the problem.

Methodology:
1. Built the meshes making 3 geometric parameters of the domain vary.
2. Use traditional FEM solver to obtain the solution (of the electrical part of the problem) for each case.
3. Train a neural network (GCA-DL-ROM) as a surrogate model for this problem.
4. Couple this efficient ROM with a traditional solver (for the mechanical part of the problem) to obtain the motion inside the MEMS.

04/2025 - Current	**Coupling MPE and Stokes' equations for cerebrospinal fluid flow and tissue motion**

Reference: 🔗

Objective: study cerebrospinal fluid (CSF) flow, inside brain ventricles and subarachnoid space, with a focus on modeling the latter and exploiting already existing results.

Dataset: not publicly available.

Methodology:
1. *Implementation challenges:* segmenting the geometry (obtained from MRI) and creating the mesh of the subarachnoid space.
2. *Mathematical model:* coupling of MPE for brain tissue poromechanics Stokes' equations for cerebrospinal fluid flow.
3. *Numerical tools:* high order discontinuous Galerkin method on polytopal meshes for spatial discretization.

03/2025 - 05/2025	**C++ Scientific Computing Projects**

1. Some optimization methods for real-valued functions (Gradient Descent, Heavy Ball, Nesterov, ADAM...)
2. Parallel implementations of two kind of solvers for the Poisson equation in the unit square (Schwarz method)
3. Implementation of a matrix class, particularly suited for sparse matrices (CSR/CSC formats and modified formats)

12/2024	**Mars Terrain segmentation**

Objective: segment Mars terrain images into five classes: Background, Soil, Bedrock, Sand, and Big Rock.

Dataset: 2,615 grayscale images (64x128 resolution), filtered to 2,505 images.

Methodology:
1. Built an initial encoder-decoder architecture as benchmark.
2. Added layer for Edge Detection, Thresholding and others methods of computer vision.
3. Implemented a dual UNet architecture (Global and Local perspectives).
4. Designed custom loss functions and loss schedules.
5. Applied data augmentation and fine-tuned optimization hyperparameters.

11/2024	**Blood Cell Classification**

Objective: perform an 8-class classification task on blood cells images.

Dataset: 13,759 RGB images (96x96 resolution), filtered to 11,959 images after preprocessing.

Methodology:
1. Built an initial CNN architecture with regularization and augmentation as benchmark.
2. Implemented Transfer Learning (TL) and Fine Tuning (FT).
3. Deployed an ensemble of the best-performing models.

04/2024 – 06/2024	**Statistical Inference for Math Performance**

Objective: build a linear regression model for math perfomance of italian high school students.

Dataset: OECD PISA 2022 survey.

Methodology:
1. Non-parametric ANOVA (Kruskal-Wallis and Dunn's test).
2. Removal of influential points (outliers and leverages).
3. Cross-validation.
4. Prediction and confidence intervals.

‣ SKILLS

Programming Languages	Python, C/C++, MATLAB, R, LaTeX
Libraries	NumPy, SciPy, scikit-learn, TensorFlow, Keras, Pandas, Matplotlib, Seaborn, MIP, FEniCS, FEniCSx
Operating Systems	Linux (Ubuntu), Windows
Additional Software	Notion
Other skills	Method of loci, Mnemonic major system, Mnemonic link system

‣ LANGUAGES

Italian	Native speaker
English	C1 (IELTS 7.5)

‣ HONOURS AND AWARDS

25/01/2023	**Premio Migliori Matricole aa 21-22 Classe L 8 Fondo Giovani**
	Best Freshmen Award, academic year 2021–2022, Class L-8, Fondo Giovani — granted upon completion of the first year of enrollment, based on academic performance, including GPA and the number of ECTS credits earned.

‣ MEMBERSHIPS

2025 - Current	SIAM (Society for Industrial and Applied Mathematics)
2021 – Current	AIM (Associazione Ingegneri Matematici)

‣ VOLUNTEERING

2020 - Current	Blood donor
2018	ABCDigital: Liceo Scientifico Elio Vittorini promoted a project to organize a free course for senior citizens, consisting of 10 weekly lectures (2 hours each), aimed at improving their digital skills, device usage, and online awareness.