

# Luca Lombardo

COMPUTATIONAL MATHEMATICS · COMPUTER SCIENCE

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## Education

### BSc in Computational Mathematics

UNIVERSITY OF PISA

Pisa, Italy

Sep 2019 - May 2025

### MSc in Computer Science

UNIVERSITY OF PISA

University of Pisa, Italy

May 2025 - May 2026 (expected)

## Experience

### Student Researcher: Algorithms & Data Structures

UNIVERSITY OF PISA, DEPARTMENT OF COMPUTER SCIENCE

Pisa, Italy

May 2024 - Present

- Currently working on and developing novel succinct data structures with applications in high-performance bioinformatics.
- Implementing Rust libraries with a focus on memory efficiency and speed for compressed data representations.

### Teaching Assistant: High Performance Mathematics

UNIVERSITY OF PISA, DEPARTMENT OF MATHEMATICS

Pisa, Italy

April 2024 - July 2024

- Scaled and managed a Linux HPC cluster (from 20 to 40 nodes) using Ansible, supporting parallel scientific computations.
- Mentored students on projects using C/C++/Julia with OpenMPI, focusing on debugging and performance optimization of scientific code.

### System Administrator

UNIVERSITY OF PISA, DEPARTMENT OF MATHEMATICS, PHC

Pisa, Italy

January 2024 - Present

- Managed and automated Linux systems supporting research computing (SysOps/DevOps); experience with Docker, Puppet and Prometheus.
- Developed Python/Bash scripts for system automation and health monitoring in a multi-user scientific environment.

## Personal Projects

### [1] Compressed Integer Vector Library

DATA STRUCTURES, ALGORITHMS, COMPRESSION, RUST

A **Rust library** that provides space-efficient, in-memory representations for integer vectors.

### [2] A Cache Efficient, Low Memory, Lanczos Algorithm

RUST, HPC, NUMERICAL LINEAR ALGEBRA, KRYLOV METHODS

A high-performance linear algebra library in **Rust** implementing a two-pass Lanczos algorithm for computing the action of matrix functions.

### [3] An exact and fast algorithm for computing top-k closeness centrality

GRAPH ALGORITHMS, MULTI-THREADING, OPTIMIZATION, C++

Developed a **multi-threaded C++** algorithm to compute top-k centrality efficiently on very large graphs.

### [4] Numerical methods for solving PageRank with multiple damping factors

NUMERICAL LINEAR ALGEBRA, KRYLOV METHODS, OPTIMIZATION

Implemented efficient **numerical algorithms** (Krylov-based) for PageRank, relevant for solving large matrix problems in network analysis.

## Scientific Interests

### Algorithm Engineering

- Strong knowledge of advanced data structures (Suffix Arrays, FM-Index, Wavelet Trees) for efficient data representation and retrieval.
- Keen interest in bridging theoretical concepts with practical low-level algorithm engineering for real-world applications.
- Strong experience with succinct data structures and compression algorithms

### High Performance Computing

- Developed parallel algorithms (MPI/OpenMP) optimized for distributed/shared memory systems in scientific computing contexts.
- Experience engineering scalable solutions for computationally intensive tasks, including performance analysis and debugging.
- Proficient in performance optimization and resource management on Linux-based cluster environments.

### Numerical Linear Algebra & Optimization

- Experience with numerical methods for large linear systems (CG, GMRES), eigenvalues, ODE, PDE and their application to scientific modeling.
- knowledge of mathematical optimization techniques, including gradient-based and derivative-free methods for various applications.
- Practical experience with implementing low-level numerical algorithms in high-performance computing contexts.

## Skills

### Programming

Rust, C/C++, Python (NumPy, SciPy, Pandas, Matplotlib etc.), Julia, Matlab, Lean4, F#

### Tools & Frameworks

Git, Docker, Linux CLI, HPC (MPI, OpenMP), Ansible, Puppet, Prometheus, Grafana