Luca **Lombardo**

Mathematics · Computer Science

☎ (+39) 346 2743119 | ✉ l.lombardo@pm.me | ⌂ lukefleed.xyz | lukefleed | l-lombardo

Experience

Student Researcher: Algorithms & Data Structures
Pisa, Italy

University of Pisa, Department of Computer Science
May 2024 - Present

- Researching on new efficient succinct data structures: space-time trade-offs, entropy bounds and practical applications.
- Implementing Rust libraries with bit-level memory control; optimized for cache locality and minimal allocations.

Teaching Assistant: High Performance Computing
Pisa, Italy

University of Pisa, Department of Mathematics
April 2024 - July 2024

- Scaled a Linux HPC cluster from 20 to 40 nodes; managed job scheduling and resource allocation.
- Mentored students on parallel algorithms (C/C++/Julia, OpenMPI); guided profiling and vectorization of compute-intensive kernels.

System Administrator
Pisa, Italy

University of Pisa, Department of Mathematics, PHC
January 2024 - Present

- Automated Linux infrastructure for research computing: configuration management (Puppet), monitoring (Prometheus), containerization (Docker).
- Developed Python/Bash tooling for system health monitoring and resource tracking in multi-user HPC environment.

Personal Projects

[1] Compressed Integer Vector Library

Rust, Bit Manipulation, Succinct Data Structures

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

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

Rust, Numerical Linear Algebra, Cache Optimization

Two-pass Lanczos with $O(n)$ memory; exploits **cache locality** to outperform standard $O(nk)$ implementations on large sparse systems.

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

Graph Algorithms, Multi-Threading, Optimization, C++

Multi-threaded C++ algorithm to compute top-k centrality efficiently on very large graphs.

[4] Efficient Succinct Data Structures on Directed Acyclic Graphs

Bachelor Thesis in Mathematics

A **novel succinct data structure** for DAGs that efficiently support queries while maintaining space usage below the entropy of the underlying graph.

Core Competencies

Algorithm Engineering

- Succinct data structures; strong foundation in algorithm design and analysis.
- Translating abstract algorithmic ideas into low-level, performance-predictable code.
- Bit-level optimization: sub-word access, cache-aware layouts, space-time trade-off analysis.

Systems Programming

- Memory-aware programming: ownership models, manual memory management, unsafe Rust for zero-copy operations.
- Performance profiling: benchmarking, flame graphs, cache-miss analysis.
- Hardware-aware optimization: reasoning about memory latency, branch prediction, and generated assembly.

Computational Mathematics

- Iterative solvers for large sparse systems: Krylov methods (CG, GMRES, Lanczos), preconditioning, convergence analysis.
- High-performance linear algebra: BLAS-aware implementations, sparse matrix formats, memory-bound kernel optimization.
- Optimization fundamentals: convex methods, approximation algorithms, complexity-performance trade-offs.

Education

BSc in Computational Mathematics
University of Pisa, Italy

University of Pisa (Thesis: Efficient Succinct Data Structures on DAGs)
May 2025

MSc in Computer Science
University of Pisa, Italy

University of Pisa
May 2026 (Expected)

Skills

Programming	Rust, C/C++, Python, Julia, Matlab/Octave, Lean4, F#
Tools & Frameworks	Git, perf, MPI, OpenMP, Docker, Ansible, Puppet, Prometheus