

Rounak Ghosh

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EDUCATION

Indian Institute of Technology Guwahati

Bachelor of Science in Data Science and Artificial Intelligence

Expected Graduation: Oct 2029 (4 years)

CGPA: 7.15

PROJECTS

blas-rs — BLAS & Intel MK Library x86_64 Implementation in Rust (github)

- Ported core **Level 1, 2, and 3** BLAS routines from Fortran 77 reference to pure Rust, preserving numerical accuracy and Intel oneMKL compatibility for the most frequently used kernels
- Engineered SIMD-accelerated kernels via `std::arch::x86` AVX2 intrinsics, achieving competitive single-thread performance against Intel MKL
- Surpassed Intel MKL by up to **45%** in DOT and matched AXPY, GEMV and other Level 1 around **98%** that of MKL in GFLOPS & Latency, while maintaining reasonable compact data-alignment, less branch hot paths and **cache-blocking techniques**.
- Created an open-source performance reference documenting compiler behaviour, x86 microarchitecture trade-offs, and native **CPU acceleration techniques** for numerical computing.

proxy-graph — Generic HNSW Approximate Nearest Neighbor Library in Rust (github)

- Implemented a paper-compliant Hierarchical Navigable Small World (**HNSW**) index in pure Rust, supporting configurable M, ef_construction, ef_search, and multiple distance metrics (**Cosine, Euclidean, Dot**).
- **Achieved 98.45% Recall@12 at 3,330 QPS** on 153k vectors of dim 1536 (dbpedia-entities-openAI); an i8-quantized variant reached **5,832 QPS with a 72% smaller** on-disk index (280 MB <- 989 MB), on a single consumer CPU.
- Benchmarked simple (Alg. 3) vs. heuristic (Alg. 4) neighbor selection, quantifying the **recall/build-time trade-off** across M values; documented findings and optimization guidance.
- Designed a clean **portable SIMD** and x86_64 specific **vector optimizations**, well-documented API with optional heuristic selection, automatic layer promotion, and incremental insertion, making the implementation suitable for both learning and production use.

rdrive — Zero-Trust Distributed Storage Node in Rust (github)

- Built a multi-tenant, zero-trust storage node with **Content-Addressable Storage** and **Docker Hub Layered Chunking**; only modified chunks are transferred, and file pull of 2 GB completes in 1.016s on a cache chunks hit.
- Designed a custom SSH-style handshake (Ed25519 identity, X25519 encryption) that processes **872 handshakes/sec** at **P50 latency of 2.59 ms**, outperforming standard TLS in benchmarks.
- Migrated the entire server to an async **Tokio architecture** with per-connection global memory pools, supporting 'N' concurrent connections with Ratelimits, reducing allocation overhead, and achieving push throughput of 2 GB in 1.43s.
- Implemented a **filesystem-native database** where directories serve as hash tables for O(1) lookups, with isolated user key-spaces, **secure key rotation**, and **whitelist-based access control**.

missile-sim — ML Missile Guidance & Kinematics Simulation Engine in Rust (github)

- Implemented five 3D guidance laws (Pure/True/Augmented Proportional Navigation, Pure & Lead Pursuit) with configurable navigation constants, closing speeds, and target maneuvers.
- Engineered a high-fidelity numeric solver with fine-grained time steps ($dt = 0.01s$) and a hit-threshold criterion, enabling accurate intercept trajectory computation and miss-distance analysis.
- Ran Monte Carlo benchmarks across 10k random scenarios; PPN achieved 84.7% hit rate with an average impact time of 19.59s and 573m mean miss distance, outperforming PP (12.3% hit rate).
- Generated structured training datasets (position, velocity, acceleration, LOS rates) from all simulations, designed for machine learning model training on guidance law performance prediction.

TECHNICAL SKILLS

Languages: Rust, C++, Python, Java, Bash, Perl

Technologies: Linux, Docker, Tokio, Axum, Intel oneAPI & Vtune, Oracle Cloud, Unreal Engine 5, Godbolt Compiler Explorer, GDB, Wireshark

Interests: Systems and Network Programming, x86 Architecture, Databases Internals, Open-Source Tools/Libs, Game Dev, Performance engineering