

# Nils Matteson

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## Education

### University of Wisconsin–Madison

B.S. Data Science, Minor in Computer Science

Madison, WI

Expected May 2026

- **Relevant Coursework:** Artificial Intelligence (CS 540), Machine Organization (CS 354), Data Structures & Algorithms (CS 400), Discrete Mathematics (MATH 240), Linear Algebra (MATH 340), Statistical Modeling (STAT 340).

## Technical Skills

**Languages:** Python, Rust, Go, C++, TypeScript/JavaScript, SQL

**ML & AI:** PyTorch, Transformers, LLMs, Stable Diffusion, Scikit-learn, Hugging Face, OpenCV

**Systems & Cloud:** Distributed Systems, gRPC, Docker, Kubernetes, AWS, GCP, Redis, Kafka, PostgreSQL

**Web & Graphics:** React, Next.js, WebSockets, Three.js, WebGL, GLSL Shaders

## Selected Projects

### Sentinel: Distributed Log Streaming Engine

Go, gRPC, Protobuf, LSM Trees, Raft Consensus

Production-grade distributed message queue architected from scratch — 5,600+ lines of systems code.

- Engineered custom LSM-tree storage engine with skip list memtable achieving **1.7M writes/sec** and **3.9M reads/sec**; CRC32 checksums, bloom filters, and crash-safe write-ahead logging.
- Built Raft consensus layer for fault-tolerant leader election and log replication with randomized timeouts, AppendEntries RPC, and majority-quorum commit protocol.
- Designed gRPC streaming API with Kafka-style topic/partition semantics, consumer groups, offset tracking, and Prometheus-compatible metrics (p50/p95/p99 latency).

### Madison Metro: Autonomous ML Bus Prediction System

Python, XGBoost, Flask, PostgreSQL, React,

GitHub Actions

End-to-end MLOps pipeline with automated retraining, model registry, and live inference serving.

- Architected data pipeline ingesting **50K+ daily GTFS-RT observations** via polling daemon with data validation, deduplication, and schema enforcement before PostgreSQL feature store ingestion.
- Built autonomous ML pipeline: nightly XGBoost on 14-day sliding window, **automated A/B comparison** (deploy if F1 >1% improvement), immutable model versioning with lineage tracking.
- Deployed Flask inference API with **sub-50ms P95 latency**; feature engineering at request time (temporal encoding, route embeddings, delay aggregations) with request logging for drift monitoring.
- Shipped React dashboard with real-time bus tracking, delay heatmaps by route/time, model performance metrics (accuracy, F1, precision/recall), and training run history; CI/CD via GitHub Actions.

### Synapse: Real-time Collaborative Whiteboard

Rust, WebAssembly, WebSockets, CRDTs (Yjs), Redis Pub/Sub

Lock-free distributed canvas supporting 50+ concurrent editors with sub-100ms sync latency.

- Built Rust WebSocket server (Actix) with CRDT state sync (Yjs) for conflict-free concurrent editing without operational transforms or central locking.
- Compiled rendering to WebAssembly achieving **60 FPS** with 10K+ vector objects; R-tree spatial indexing for viewport culling.
- Architected horizontal scaling via Redis Pub/Sub with connection draining and session affinity for zero-downtime deployments.

### Aura: 3D Audio-Reactive AI Visualizer

Three.js, WebGL, GLSL Shaders, Stable Diffusion, Whisper

GPU-accelerated generative art syncing procedural 3D visuals with real-time audio at 60+ FPS.

- Developed audio reactivity pipeline: FFT frequency band extraction mapped to GLSL shader uniforms for beat-synced geometry morphing.
- Integrated Whisper transcription + Stable Diffusion for semantic texture generation based on detected song themes and mood.
- Authored custom ray-marching fragment shaders for volumetric god rays; optimized GPU memory with texture atlasing.