Joey Beauvais-Feisthauer, PhD

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Education

Wayne State University | *PhD in Mathematics* — *Detroit, MI* | 2020 — 2025

- Thesis: **Automated Inference in the Adams spectral sequence** – Introduces two novel algorithms for automated differential deduction in spectral sequences: a local algorithm based on a careful bookkeeping of affine spaces, and a global algorithm that rephrases the problem as an instance of the boolean satisfiability (SAT) problem.

Western University (UWO) | *MSc in Mathematics* — *London, ON* | 2018 — 2019

University of Ottawa | *Honors BSc in Mathematics (magna cum laude)* — *Ottawa, ON* | 2012 — 2018

Research & Work experience

Lead, Adams E_2 page through stem 400, distributed over GPUs in Rust + CUDA (talk) — 2026

- Extended the largest computation in my field to stem 400: a 37-day, ~25,000 GPU-hour run on up to 45 GPUs (H200, L40S, V100, A30) on a shared Slurm cluster; fault-tolerant, upgraded live ~20 times. Complete agreement with independent results.
- Row reduction over $\mathbb{F}_2$ built on the GPU GEMM below: a 1,048,576 × 1,048,576 matrix (137 GB) in 12 min on one H200, against ~35 h extrapolated for the best CPU code; production results Freivalds-verified.
- A benchmark workload went from 205.5 h on one node to 28.3 h on 23 GPUs. Milnor-multiplication kernels: ~37× via rewrites. Traded storage for recompute: projected disk 12 PB → ~100 GB, peak memory 700 GB → 45 GB.

Lead Developer, SpectralSequences Project (github.com/SpectralSequences/sseq) — 2023 — present

- Wrote an $\mathbb{F}_2$ matrix-multiply kernel for Hopper's 1-bit tensor cores (`wgmma.b1` PTX; TMA 128B-swizzled loads, warp-specialized pipelining, persistent kernels with grouped rasterization): 10,031 binary TOPS on one H200, 14.5× the best GPU alternative and 331× the best CPU code at the same size.
- Wrote a CPU-based $\mathbb{F}_2$-GEMM achieving over 1 binary TOPS on a single core using a handwritten AVX-512 microkernel.
- Architected a type-safe, SIMD-accelerated finite field library (primes up to $2^{31}-1$, prime powers via Zech logarithms).
- Developed wait-free, write-once, trie-backed atomic data structures indexed by arbitrary tuples of integers.
- Put in place 400+ property-based tests (`proptest`) and `loom`/`miri` tests against UB and atomic memory ordering issues. Instrumented with `tracing`, which found a priority inversion; fixing it gave a 2× speedup.

Author, SeqSee: Spectral Sequence Visualizer (github.com/JoeyBF/SeqSee) — 2024 — present

- Converts JSON data into self-contained interactive HTML charts for self-hosting, used by top researchers in the field. Added a WebGL2 renderer that fits the full stem-400 chart (1.1M nodes and edges) into a 1.4 MB file that decodes in ~130 ms.
- Supports multi-page collections, KaTeX, pan/zoom, custom theming, with a `pydantic`-backed JSON schema. Built in Python with a Nix-flake development shell, `uv`, `ruff`, `pyright`, and published on PyPI.

Instructor of Record | Wayne State University — *Detroit, MI* | 2020–2023

Courses: College Algebra (x2), Calculus I (x1); emphasized deep understanding over rote.

Publications

- **The E_2 Page of the 2-Primary Adams Spectral Sequence in a Large Range** (Zenodo 2023, with Dexter Chua and Hood Chatham) – doi: 10.5281/zenodo.8021736 — Used Slurm on the Wayne State HPC Grid to run a 5300+ CPU-day distributed computation on 19 64-core nodes, outputting 22.9 TB of compressed data. State of the art at release; used by leading researchers in the field.
- **Milnor–Moore theorems for bialgebras in characteristic zero** (J. Algebra 2023, with Yatin Patel and Andrew Salch) – doi: 10.1016/j.jalgebra.2023.02.020 — Extended the Milnor–Moore theorem to certain bialgebras without antipodes.

Additional Information

- **Programming Languages**: Rust (5 years, primary), CUDA/PTX, Python (15 years, intermittent), C/C++, x86-64 ASM, C#, Java, WGSL | Bash, HTML/CSS, JavaScript, JSON, YAML | Typst, KaTeX, SVG | Glucose, CryptoMiniSat, Lean, Rocq
- **Development Tools**: VSCode, Neovim | cargo ecosystem (Rust), cudarc, NVRTC, uv, ruff, pyright (Python) | NixOS, Nix flakes, direnv | Slurm, Redis, Celery, GitHub Actions
- **Testing & Performance**: proptest, Miri, Loom, Criterion, perf, flamegraph, tracing, Nsight
- **Human Languages**: French (native), English (functionally native), German/Russian (B1+)
- **Interests**: Crosswords (NYT Thursday solver, aiming for Saturday), chess (Chess.com 1500 Rapid), cooking, cinema