Joshua NANCEY

Mathematical Modeling, OR & AI Research Engineer

M.Eng. UTC (**Mod'Math Honors**) • Optimization, Stochastics & Statistical Risk Control

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Paris, France (Open to Relocation: EU / CH / UK)



Education

▸ **Master of Engineering (M.Eng.) in Computer Science, AI & Mathematical Modeling** *2023 – 2026*

Université de Technologie de Compiègne (UTC) *Compiègne, France*

- **Mathematical Modeling Track (*Label Mod'Math*):** Convex & Combinatorial Optimization (Simplex, Duality, KKT conditions, Augmented Lagrangian, Gradient methods — *RO04*), Operations Research & Stochastic Modeling (Markov Chains, Poisson Processes, Queuing Theory, Discrete-Event Simulation — *RO05*), Numerical Matrix Analysis & ODEs (SVD, QR, Runge-Kutta — *MT09*).
- **Statistical Learning & AI:** Parametric Estimation, Hypothesis Testing & Confidence Intervals (*SY02*), Multivariate Statistical Analysis & Clustering (*SY09*), Bayesian Decision Theory, Deep Learning & Computer Vision (*SY32*).

▸ **Preparatory Classes for Grandes Écoles (CPGE PTSI / PT — Intensive Math & Physics)** *2020 – 2023*

Lycée Raspail *Paris, France*

Research & R&D Engineering Experience

▸ **Epiconcept — R&D Data Science & Epidemiology Lab** *March 2026 – Sept. 2026 (6 months)*

AI Research Intern — Statistical Risk Guarantees, Medical Computer Vision & Clinical LLMs *Paris, France*

- **Distribution-Free Selective Classification (*SGR* & Hoeffding Bounds):** Implemented and extended Geifman & El-Yaniv's framework to a dual-threshold (τ_-, τ_+) clinical triage rule, guaranteeing simultaneous finite-sample bounds ($1-\delta$) on False Negative Rate (FNR ≤ 5%) and False Positive Rate (FPR ≤ 5%) via Hoeffding inversion, combined with **MC Dropout** and **Deep Ensembles**.
- **High-Resolution Medical Vision (GMIC):** Fine-tuned the interpretable **GMIC** architecture (**ResNet-22** global saliency + **ResNet-18** ROI patch attention) in 16-bit precision on 300+ GB of RSNA mammograms (2944×1920, 2.1% malignancy rate), improving test AUC from 0.683 to **0.889** (95% CI: [0.858, 0.921]).
- **Grounded Clinical LLM Extraction (ECDC European Surveillance):** Benchmarked 20 local LLM configurations (**MedGemma-4B/27B**, **Gemma-2-27B**, **Qwen-2.5-32B**) on MIMIC-IV patient records under a strict single-GPU **NVIDIA A100 40 GB** budget; engineered a deterministic verbatim-quote verifier (`evidence_is_grounded`, **F1 = 0.91**) and achieved **F1 = 0.88** in zero-shot cross-lingual transfer to Croatian.
- **Scientific Dissemination:** Co-authored an 8-chapter containerized training capsule (**Quarto** / **Jupyter** / **Docker**) on deep learning risk control.

▸ **BMBI Laboratory (CNRS UMR 7338 / UTC)** *Sept. 2025 – Jan. 2026 (5 months)*

Graduate Research Project (TZ2) — 3D/4D Implicit Neural Surfaces & Differential Geometry *Compiègne, France*

- **Continuous Space-Time Implicit Surfaces $f_\theta(x,y,z,t) = 0$:** Modeled 3D/4D deformable biological membranes (Kuchel red blood cells and micro-capsules in shear flow) using **SIREN** ($\sin(\omega_0 \cdot)$) networks, Fourier positional encoding, and **Eikonal regularization** ($||\nabla f|| = 1$), achieving **99.65% IoU** on non-affine temporal deformations.
- **Analytical Parsimony vs. Neural Over-Parameterization:** Proved that degree-4 polynomial regression recovers the exact analytical Kuchel quartic in **10 coefficients** (machine-zero residual) vs. 197,886 neural weights.
- **Mesh-Free Differential Geometry:** Computed exact Gaussian (K) and Mean (H) curvatures directly via **2nd-order PyTorch `autograd`** (gradient & Hessian), numerically verifying the **Gauss-Bonnet theorem** ($\oint K\, dA = 4\pi$) to **0.025% accuracy**.

▸ **Aubay — Innovation Department** *Sept. 2024 – Feb. 2025 (6 months)*

Data Science & AI Research Intern — Contextual Anomaly Detection *Boulogne-Billancourt, France*

- **Contextual Outlier Detection on Mixed Tabular Data:** Benchmarked deep tabular architectures (**GANDALF**, **FT-Transformer**, **TabTransformer** via PyTorch Tabular) alongside **Isolation Forest** and **Deep Isolation Forest** (**F1 = 0.903**, **ROC-AUC = 0.985**).
- **Software Engineering:** Built a reproducible full-stack audit platform (**Flask** REST API, **React**, **AWS S3**, **Conda** / **Docker**).

Selected Scientific & Systems Projects

▸ **Statistical Learning, Wald Hypothesis Testing & Adaptive Clustering (SY09)** *Python, Scikit-Learn, Statsmodels*

- Implemented logistic regression with **Wald statistical tests**, Bayesian classifiers, and **Gower-distance** / **Adaptive Mahalanobis K-Means** on mixed clinical cardiac datasets.

▸ **Jarvis & Simulation-Go (IA04) — Grounded Multi-Judge LLM Engine & Multi-Agent System** *Python, FastAPI, SQLite FTS5*

- Built a 2-pass, 3-LLM evaluation jury with deterministic substring grounding (**SQLite FTS5 BM25**) and a concurrent autonomous multi-agent simulation engine in **Go (Golang)** with real-time web visualization.

Technical Skills

Mathematics & OR : Convex/Combinatorial Optimization, Markov Chains, Poisson/Queues, Hypothesis Testing, Hoeffding Bounds, 2nd-Order Autograd

Deep Learning & AI : PyTorch, Hugging Face, PyTorch Tabular, Scikit-Learn, SIREN/Implicit Nets, OpenCV

Languages : Python, C/C++17 (Qt 6), SQL, R, Scilab/MATLAB, Kotlin, Bash, LaTeX / Quarto

Systems & Languages : Linux, Docker, Git, FastAPI/Flask, French (Native), English (Professional B2+)