Jacob C. Metzger

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Professional Summary

Machine Learning Scientist and Research Engineer with 8+ years of experience specialized in the intersection of probabilistic modeling and production software systems. Expert in deriving and deploying uncertainty-aware AI solutions, ranging from Bayesian digital twins and causal inference engines to multimodal agentic workflows. Proven ability to bridge the gap between high-level statistical research (MCMC, UQ) and scalable engineering (LangGraph, gRPC, distributed GPU training).

Focus Areas: Probabilistic Modeling • Causal Inference • Agentic Systems • Bayesian Learning • Uncertainty Quantification • Generative AI

Technical Skills

- **Probabilistic Modeling**: PGMs, Causal Inference (DAGs, counterfactuals), MCMC, Variational Inference, Bayesian NNs, UQ, Conformal Prediction.
- **Machine Learning**: PyTorch, TensorFlow, NLP, Computer Vision (Stable Diffusion, VLMs), Active Learning.
- **Probabilistic Programming**: Pyro, NumPyro, Stan, ArviZ, R.
- **AI Orchestration**: LangGraph, LangChain, Hugging Face, Agentic Workflows, GraphRAG.
- **Infrastructure & MLOps**: AWS, GCP, Azure, Docker, Kubernetes, gRPC, PostgreSQL (pgvector).
- **Languages**: Python, Scala, Java, C++, SQL.

Professional Experience

Independent AI Consultant | Research Machine Learning Engineer

San Francisco, CA • Nov 2025 – Present

- Architecting hybrid agentic memory systems utilizing PostgreSQL (pgvector) and GraphRAG for long-term state persistence and coherence.
- Developing reasoning engines utilizing probabilistic justification logic to ground agentic decision-making via noisy-OR gate evidence aggregation.
- Engineering agentic AI recommendation platforms for real estate investment optimization for enterprise clients.

GoFundMe | Senior Machine Learning Engineer

San Francisco, CA • Jul 2025 – Nov 2025

- Executed architectural audits and bias evaluations for generative AI pipelines (image and text-to-image).
- Developed counterfactual fairness frameworks to detect and remediate linguistic social bias in model outputs.
- Prototyped UQ frameworks (Conformal and Venn-ABERS prediction) to establish calibration and monitoring standards.
- Built "PromptForge," an automated prompt optimization and monitoring module via DSPy (Top-ranked Hackathon Project).

Aktus.AI | Principal ML Scientist and Senior Technical Lead

San Mateo, CA • Jun 2024 – Jan 2025

- Deployed an end-to-end agentic document ingestion platform for regulated enterprise clients using OCR, RAG (STORM/RRR), and state-machine routing (LangGraph).
- Designed deep vision models and extraction pipelines using VLMs (PaliGemma) for semantic parsing of engineering charts.
- Configured multi-GPU distributed training topologies (NVIDIA H100) for internal VLM fine-tuning and model cascading.

Aktus.AI | Lead Machine Learning Engineer – Vision

San Francisco, CA • Mar 2024 – Jun 2024

- Evaluated and fine-tuned latent diffusion architectures (Stable Diffusion) for structural data visualization.
- Executed parameter-efficient concept injection (DreamBooth) to model geometric and semantic constraints.

Accenture Labs | Associate Principal R&D Scientist

San Francisco, CA • Nov 2021 – Jan 2024

- Architected probabilistic digital twins for supply chain macro-simulation using causal Directed Acyclic Graphs (DAGs) and grounded counterfactual analysis.
- Implemented Bayesian Online Changepoint Detection (BOCPD) to identify structural supply shocks.
- Resolved pathological MCMC sampling geometry (multimodality, low ESS) in PyMC using hierarchical models and empirical bounds.
- Co-authored Accenture Labs' first code of research values and ethics; core contributor to the TEthER algorithmic audit initiative.

OSARO, Inc. | Machine Learning Engineer

San Francisco, CA • Oct 2019 – Oct 2021

- Created production ML models for robotic bin picking using multimodal sensor data, improving pick success by 14%.
- Engineered an online tool change optimizer utilizing a receding causal horizon and affordance map reward estimation.
- Executed variance decomposition on GQFCN models via deep ensembles to isolate epistemic uncertainty for OOD detection.

Accenture Liquid Studio | Data Scientist

San Francisco, CA • Sep 2018 – Oct 2019

- Co-invented "onyxAI," a patented explainable recommendation engine utilizing a semantically grounded vector space model and Empirical Bayes regularization.
- Engineered NLP pipelines for discrete semantic evidence extraction and real-time counterfactual evaluation.

Applied Research & Projects

- **Agentic Memory & Reasoning**: GraphRAG-based long-term memory and Probabilistic Justification Logic for agent grounding.

- **Causal Inference & Digital Twins**: Counterfactual analysis for systemic shocks and Bayesian Online Changepoint Detection.
- **Uncertainty Quantification**: Conformal Prediction, Venn-ABERS, and variance decomposition for OOD detection in production.
- **Explainable AI**: Semantic vector space models for interpretable recommendation (Patent 11,694,102).

Education

- **University of Illinois at Springfield** | MS in Computer Science • May 2017
- **University of Arizona** | BA in Mathematics, Philosophy; Minor in Physics • Dec 2010

Publications & Presentations

- **A Bayesian Approach to Constructing Probabilistic Models from Knowledge Graphs**, IJSC, Dec 2023.
- **Online Tool Selection with Learned Grasp Prediction Models**, IEEE ICRA, May 2023.
- **Ontology Modeling for Probabilistic Knowledge Graphs**, IEEE ICSC, Feb 2023.
- **Talk (2025)**: "The Best Worst Model" (UQ in ML), GoFundMe.
- **Talk (2025)**: "Conformal and Venn-ABERS Prediction", GoFundMe MLL.

Patents

- 2023 – AI-Based Optimization And Management of Supply Chain Networks
- 2023 – System For Probabilistic Modeling And Multi-Layer Modeling For Digital Twins
- 2022 – Automated Robotic Tool Selection
- 2019 – Explanation-Driven Reasoning Engine (Issued 2023)

Honors & Certifications

- 2025 – Top-ranked Hackathon Project (PromptForge), GoFundMe
- 2023 – Outstanding Thought Leadership, Accenture Labs
- Certifications: Deep Learning Specialization (DeepLearning.AI), Machine Learning (ColumbiaX), Functional Programming in Scala (EPFL).