# Paul E. Bergeron, Ph.D.

**Software & ML Systems Engineer • Multimodal AI • Ph.D. Scientist**

Holton, KS | (912) 610-2441 | Bergeron339@gmail.com | drbee.me

## SUMMARY

Software and ML systems engineer and Ph.D. scientist specializing in **frontier multimodal AI**. I build production systems end-to-end — data-curation & quality pipelines, large-scale evaluation and reward frameworks, multimodal understanding & generation, and agentic systems with tool use and real-time streaming — from prompt and agent-loop design through cloud deployment. A doctorate and peer-reviewed research background bring rigorous study and evaluation design to ML data quality.

*(This is a public version of my CV; specific employer projects are under client confidentiality. The projects below are original, open demos I built to exercise the same skills — live on my portfolio site.)*

## TECHNICAL SKILLS

**Languages:** Python (expert), Bash, SQL, R, JavaScript, C++, HTML/CSS

**Multimodal:** vision & OCR understanding, text-to-image / video / speech generation, document and signal analysis, image–text consistency checking

**Data pipelines at scale:** acquisition / crawling, preprocessing, filtering, dedup, human + synthetic curation, quality studies

**Evaluation & reward modeling:** rubric systems, LLM-judge loops, benchmark design, ELO / win-rate / slop analysis, calibration

**ML & LLM:** multi-provider agent loops, prompt engineering, RAG & embedding search, autoresearch optimization, PyTorch-based embedding models

**Full-stack & cloud:** FastAPI, async, real-time streaming (SSE), GCP (GCE / IAP / LB / GCS), Docker, nginx, systemd, high-throughput concurrency

**Agent architecture:** planner / worker / judge orchestration, tool use, self-correction, quality gates

**Scientific domains:** biology, chemistry, physics, ecology, agroecology; molecular methods (DNA metabarcoding, qPCR), R statistics

## SELECTED PROJECTS — ORIGINAL OPEN DEMOS

Live, interactive tools I built from scratch (Python · FastAPI · async/SSE · OpenRouter · NumPy · vanilla JS):

- **Synthetic Data Factory** — generates a synthetic dataset for any topic, auto-scores each item against a quality rubric, and filters pass/fail. *Data curation & quality.*
- **Multimodal Cross-Checker** — verifies whether an image supports a given claim and flags misleading charts (truncated axes, cherry-picked ranges). *Multimodal understanding.*
- **Auto-Rubric Evaluator** — auto-generates a weighted rubric for any task, runs two models, and grades & ranks each against every criterion. *Evaluation & reward modeling.*
- **Reflexive Agent** — answers a question with read-only tools, critiques its own draft, and revises — streamed live. *Agentic & real-time.*
- **Training-Run Automation** — an agent chooses hyperparameters, then a real image classifier trains with a live loss/accuracy curve and held-out evaluation. *ML training automation.*

## PROFESSIONAL EXPERIENCE

**Agent + Tools Team Lead — xAI** *(2025 – Current)*

- Design and ship multi-agent systems, autonomous coding agents, and LLM-driven evaluation pipelines.
- Build and operate large-scale **multimodal data-curation and quality pipelines** that feed model training and evaluation.
- Own end-to-end infrastructure — prompt and agent-loop design through production deployment on cloud (GCP) fleets, behind load balancers and IAP.

**Science Teacher — Royal Valley High School** *(2023 – 2025)*

- Designed and taught Physics, Chemistry, Plant & Soil Science, and a hands-on Research-in-Agriculture course (small-engine repair & diagnostics, basic electrical, woodworking); enrollment up 50% over two years.

**Adjunct Faculty / Visiting Professor — Heritage University & Zambian Institute of Agriculture** *(2021 – 2024)*

- Designed college-level Python, R, biology, and agroecology curricula with interactive labs; adapted for virtual instruction with ~90% positive student feedback.

## EDUCATION

**Ph.D., Entomology — Washington State University** *(2018 – 2022)*

Dissertation: *Improving conservation biological control in Washington specialty crops.* Research on ecology, integrated pest management, and molecular biology (DNA metabarcoding, qPCR).

**B.S., Biology (Minor: Chemistry) — Washburn University** *(2014 – 2018)*

Coursework in physics, chemistry, biology, ecology, and data analysis; research on stored-product pests and native forest restoration.

## SCIENTIFIC RESEARCH & PUBLICATIONS

**Peer-reviewed publications**

- Bergeron, P.E., S.J. Clary & R.J. Mercader. 2019. Influence of host-use adaptation on the dispersal propensity of *Callosobruchus maculatus*. *Journal of Applied Entomology*. doi:10.1111/jen.12632
- Bergeron, P.E. & R.A. Schmidt-Jeffris. 2020. Not all predators are equal: miticide non-target effects and differential selectivity. *Pest Management Science* 76:2170–2179. doi:10.1002/ps.5754
- Bergeron, P.E. & R.A. Schmidt-Jeffris. 2021. Twospotted spider mite miticide resistance in South Carolina strawberry. *Experimental and Applied Acarology*.
- Schmidt-Jeffris, R., Z. Snipes & P. Bergeron. 2021. Acaricide efficacy and resistance in South Carolina tomato. *Florida Entomologist*.
- Schmidt-Jeffris, R.A., E.A. Moretti, P.E. Bergeron & G. Zilnik. 2021. Nontarget impacts of herbicides on spiders in orchards. *Journal of Economic Entomology*.
- Smith, O.M., D.M.I. Jocson, … P.E. Bergeron, et al. 2022. Identifying farming strategies associated with achieving global agricultural sustainability. *Frontiers in Sustainable Food Systems* 6:882503. doi:10.3389/fsufs.2022.882503
- Emry, D.J., P.E. Bergeron & R.J. Mercader. 2024. Small-scale Amur honeysuckle (*Lonicera maackii*) removal and passive restoration may not create long-term success. *Natural Areas Journal* 44(2):98. doi:10.3375/2162-4399-44.2.98
- Bergeron, P.E. & R.A. Schmidt-Jeffris. Updating integrated mite management fifty years later: herbicide non-target effects on two key apple orchard predators. *Pest Management Science*. doi:10.1002/ps.7518
- Bergeron, P.E. & R.A. Schmidt-Jeffris. Integrated mite management fifty years later: improving orchard conservation biological control with a "new" generalist predatory mite. *Pest Management Science*.
- Moretti, E.A., P.E. Bergeron & R.A. Schmidt-Jeffris. Floral resource use by *Amblydromella caudiglans* and implications for biological control. *Journal of Economic Entomology*.

**Methods, service & honors:** DNA extraction, PCR, qPCR, MiSeq, DNA barcoding & metabarcoding; geospatial / land-use analysis; R statistics. 15+ conference presentations; peer reviewer for *Crop Protection*, *Experimental & Applied Acarology*, *Systematic & Applied Acarology*, and *Journal of Economic Entomology*. NSF & Griffin Foundation Food Security Scholarship (2019); Acarological Society of America Presentation Prize (2019); ESA President's Prize runner-up (2017).