Xin (Crystal) Qing

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RESEARCH PROFILE

PhD candidate in Nutrition and Metabolism (minor in Quantitative Biology) at the University of Wisconsin–Madison, concurrently completing an M.S. in Computer Science (Machine Learning track) at Georgia Tech. I build machine learning and computational pipelines for high-dimensional biomedical data, including single-cell transcriptomics (140K+ cells), microbiome and LC–MS/MS metabolomics, and biomedical text and knowledge graphs, and connect them to experimental work on diet–microbe–host metabolism and metabolic liver disease. Co-author on publications in PNAS and Nature Metabolism.

EDUCATION

University of Wisconsin–Madison Expected 2027
PhD, Nutrition and Metabolism; Minor in Quantitative Biology
Research focus: Food innovation and metabolic health
GPA: 3.85

Georgia Institute of Technology Expected September 2027
M.S., Computer Science — Machine Learning Track
Training in AI/ML, deep learning, data integration, bioinformatics algorithms, and high-dimensional biological data modeling
GPA: 3.66

University of Wisconsin–Madison December 2024
M.S., Nutrition and Metabolism
Research focus: Immune cell metabolism
GPA: 3.917

University of Wisconsin–Madison May 2022
B.S., Biochemistry and Nutritional Sciences (double major)
Certificate (minor): Graphic Design; Biology Core Curriculum Honors
GPA: 3.771 (major GPA 3.86)

TECHNICAL SKILLS

Machine Learning & Deep Learning: PyTorch, scikit-learn; transformers (PubMedBERT/Hugging Face), knowledge graph embeddings (RotatE), class-imbalance losses (focal loss); supervised and unsupervised learning, model evaluation, cross-validation, ablation studies

Bioinformatics & Multi-Omics: Scanpy, CellTypist, Scrublet, DecontX; scRNA-seq QC, batch integration, clustering, annotation, pseudobulk differential expression, GSEA; 16S rRNA microbiome analysis; LC–MS/MS metabolomics; multi-omics integration

Programming & Data Science: Python (NumPy, Pandas), R, statistical modeling, feature engineering, dimensionality reduction (PCA, UMAP), reproducible workflows (Git/GitHub), HPC cluster computing (UW–Madison CHTC), GPU computing (Google Colab)

Molecular & Cellular Biology: Mammalian cell culture (LX-2, HepG2, primary immune cells), Western blotting, RT-qPCR, enzyme activity assays, flow cytometry, Seahorse OCR/ECAR, ELISA, spectrophotometric assays, in vitro digestion (INFOGEST)

In Vivo Models: Murine gavage, food consumption studies, glucose/insulin/pyruvate tolerance tests, tissue preparation, fecal sample collection for 16S rRNA microbiome sequencing

Design Tools: Adobe Illustrator, InDesign, Photoshop, Premiere Pro

Languages: Mandarin (native), English (near-native fluency), Japanese (JLPT N2)

MACHINE LEARNING & COMPUTATIONAL RESEARCH

Single-Cell Transcriptomics of Liver Immune Cells in MASLD | *Python, Scanpy* 2025 – Present

- Built an end-to-end scRNA-seq pipeline for 10x Genomics liver non-parenchymal cells from germ-free and SPF mice fed high-fat ± cholesterol diets, covering QC, Scrublet doublet removal, HVG selection, PCA, batch integration, UMAP, Leiden clustering, and Wilcoxon marker discovery (180,152 → 143,221 cells × 27,120 genes).

- Benchmarked automated cell-type annotation (CellTypist, Healthy Mouse Liver model) against manual marker-based annotation, and identified a Trem2^{+}/Gpnmb^{+}/Cd9^{+} disease-associated macrophage state enriched in microbiome-colonized, cholesterol-fed mice.
- Applied pseudobulk differential expression with mice as replicates to avoid pseudoreplication and composition-driven false positives in a 2×2 diet × microbiome design.
- Designed a hepatocyte-specific workflow with DecontX ambient-RNA correction, LOESS-based QC, and reference- and marker-gated (Alb^{+}/CD45^{-}) filtering of immune contamination, and evaluated GSEA stability across GO and KEGG gene-set libraries.

Drug–Drug Interaction Extraction with Knowledge Graph Embeddings | *PyTorch, PubMedBERT* Spring 2026
Big Data for Healthcare (CSE 6250), Georgia Tech — reproducibility study, team of 2

- Reproduced a CIKM 2022 biomedical NLP model that fuses PubMedBERT text features with RotatE knowledge graph embeddings for 5-class DDI classification on the DDIExtraction-2013 benchmark.
- Built the drug knowledge graph from the DrugBank XML database and the DDI corpus (5,719 entities, 264 relation types, 479K triplets), trained RotatE embeddings, and integrated them into the classifier.
- Implemented the custom KGE–multi-focal loss and ran the loss-function ablation, in which knowledge graph embeddings raised micro-F1 from 52.0% to 80.7%.
- Identified DrugBank version drift (5.6× fewer triplets in v5.1) as the main source of the reproducibility gap and documented it.

Microbiome & Metabolomics Data Integration | *Python, R* 2025 – Present

- Integrated 16S rRNA sequencing data with targeted LC–MS/MS metabolite profiles.
- Performed multivariate statistical modeling and feature correlation analyses to identify diet–microbe–host associations.
- Applied dimensionality reduction and unsupervised clustering to explore microbial community structure.

RESEARCH EXPERIENCE

Graduate Research Assistant January 2025 – Present
Department of Animal and Dairy Sciences, University of Wisconsin–Madison

Microbial Metabolites & Liver Metabolic Health

- Design mechanistic studies of how a diet–microbiome-derived metabolite (imidazole propionate) drives hepatic metabolic reprogramming and pro-fibrogenic signaling.
- Integrate cellular bioenergetics profiling with targeted LC–MS/MS metabolite quantification to connect microbial metabolite exposure with functional liver outcomes relevant to metabolic disease.

Choline Bioavailability & Functional Ingredient Evaluation

- Develop and validate targeted LC–MS/MS methods to quantify choline metabolites, lipid oxidation markers, and microbiota-derived byproducts in biological matrices.
- Apply standardized in vitro digestion (INFOGEST) to evaluate the bioavailability and metabolic fate of choline-containing ingredients.
- Integrate metabolomics and microbiome sequencing to assess how food matrix structure and microbial transformations shape systemic and tissue-specific metabolism.
- Conduct in vivo murine studies of choline bioavailability, metabolic utilization, and protection against choline-deficiency-associated metabolic dysfunction.

Research Assistant September 2022 – December 2024
Department of Medical Microbiology & Immunology (SMPH) and Morgridge Institute for Research, University of Wisconsin–Madison

- Applied flow cytometry, metabolite assays, and proteomics to characterize neutrophil subpopulations and their functional responses during inflammation.
- Developed and executed biochemical and metabolic assays to evaluate nutrient utilization and biomarker shifts in immune cells ex vivo and in vivo.
- Investigated effects of drug interventions on macrophage metabolism using enzyme activity assays, metabolomics, and proteomics.
- Analyzed high-dimensional scRNA-seq datasets in Python/Scanpy, developing workflows for clustering, visualization, and cell-type annotation (github.com/xqing3/BMI776-Project).

Scientific Graphic Designer September 2022 – May 2025

Molecular Genetics Lab, Department of Genetics; Department of Life Sciences Communication; Division of the Arts, University of Wisconsin–Madison

- Led the creation and design of LabCulture, a cookbook of 200+ recipes gathered through interviews with scientists worldwide.
- Designed custom icons and pictograms for the cookbook and scientist biography pages.
- Translated complex scientific research into accessible, visually engaging public content, featuring renowned scientists including a Nobel laureate.

Undergraduate Researcher March 2020 – May 2022

Biochemical and Molecular Nutrition Lab, Department of Nutritional Sciences, University of Wisconsin–Madison

- Led an independent thesis project on oxidative signaling in Saccharomyces cerevisiae under zinc-limited growth.
- Applied genetic and molecular biology techniques including RT-qPCR, immunoblotting, and plasmid design and construction.
- Wrote lab manuals, research protocols, and proposals for scholarship and funding applications.

Laboratory Research Technician September 2019 – January 2020

Isotope Ratio Mass Spectrometry Lab, Biotechnology Center, University of Wisconsin–Madison

- Prepared urine and saliva samples for isotope ratio mass spectrometry.
- Analyzed energy expenditure data from Boston Weight Loss Program participants using the doubly labeled water method.
- Maintained lab instruments and equipment to keep operations running smoothly.

PUBLICATIONS

Qing, X., Goodman, R. J., Ozturk, G., Leone, V. A., & Richards, M. P. (under review). Spray drying and fluidized bed drying differentially alter microstructure, macronutrient oxidation, and digestive behavior of whey protein phospholipid concentrate. *Food Chemistry* (submitted October 2026).

Gazi, M. A.†, **Qing, X.**†, Barrett-Wilt, G., Baker, S., Richards, M. P., & Leone, V. A. (in preparation). Characterization of cholesterol oxidation products formed during thermal processing using targeted quantification and untargeted annotation. (†co-first authors)

Britt, E. C., **Qing, X.**, Votava, J. A., Lika, J., Wagner, A., Shen, S., Arp, N. L., Khan, H., Schieke, S. M., Fletcher, C. D., Huttenlocher, A., & Fan, J. (2024). Activation induces shift in nutrient utilization that differentially impacts cell functions in human neutrophils. *Proceedings of the National Academy of Sciences*. https://doi.org/10.1073/pnas.2321212121

John, S. V., Seim, G. L., Erazo-Flores, B. J., Steill, J., Freeman, J., Votava, J. A., Arp, N. L., **Qing, X.**, Stewart, R., Knoll, L. J., & Fan, J. (2025). Classically activated macrophages undergo functionally significant nucleotide metabolism remodelling driven by nitric oxide. *Nature Metabolism*, 7, 1681–1702. https://doi.org/10.1038/s42255-025-01337-3

MacDiarmid, C. W., Taggart, J., Wang, Y., Vashisht, A., **Qing, X.**, Wohlschlegel, J., & Eide, D. (2025). The interactome of the baker's yeast peroxiredoxin Tsa1 implicates it in redox regulation of intermediary metabolism, glycolysis, and zinc homeostasis. *Metallomics*, 17(8), mfaf028. https://doi.org/10.1093/mtomcs/mfaf028

Phan, L., Gatti, A., Han, Z., et al. (incl. **Qing, X.**, consortium author and benchmark dataset contributor) (2025). Humanity's Last Exam. *arXiv preprint* arXiv:2501.14249. https://doi.org/10.48550/arXiv.2501.14249

Qing, X., Chu, D., Rauf, H., & Skop, A. (2024). *Lab Culture* [Cookbook]. https://www.labculturerecipes.com/

PEER REVIEW

Reviewer, NeurIPS 2026 Workshop on Agents in the Wild: Safety, Security, and Beyond	2026
Reviewer, ICML 2026 Workshop on Agents in the Wild	2026
Reviewer, ICANN 2026 (International Conference on Artificial Neural Networks)	2026
Reviewer, Journal of Oral Microbiology (Taylor & Francis)	2026

PRESENTATIONS

Kaur, M., Chrisler, E., Gazi, M. A., Hermanson, J. B., **Qing, X.**, Prendergast, B. J., … (2026). Early-life microbial colonization shapes host circadian feeding rhythms and metabolic outcomes in mice [Abstract 349]. *Gastroenterology*, 170(6), S-1998–S-1999.

Qing, X., Richards, M., & Leone, V. Effects of spray and fluid bed drying on macronutrient stability, digestibility, and choline bioavailability of whey protein phospholipid concentrate. 2025 Dairy Innovation Hub Summit, University of Wisconsin–River Falls.

Qing, X., Richards, M., & Leone, V. Bile acids and other gut microbial metabolites as links between diet and microbe-driven metabolic dysfunction-associated steatotic liver disease. 2025 Nutritional Sciences Recruitment Symposium, University of Wisconsin–Madison.

Qing, X., & Fan, J. Neutrophil metabolic reprogramming and functional change in hyperglycemia. 2024 Diabetes Research Day, University of Wisconsin–Madison.

Qing, X., & Fan, J. Activation induces shift in nutrient utilization that differentially impacts cell functions in human neutrophils. 2024 Nutritional Sciences Recruitment Symposium, University of Wisconsin–Madison.

Qing, X., John, S., & Fan, J. Macrophages undergo functionally significant reprogramming of nucleotide metabolism upon classical activation. 2023 Nutritional Sciences Recruitment Symposium, University of Wisconsin–Madison.

Qing, X., MacDiarmid, C., & Eide, D. Effect of zinc deficiency on intracellular hydrogen peroxide level in Saccharomyces cerevisiae. 2022 CALS Undergraduate Research Symposium, University of Wisconsin–Madison.

HONORS AND AWARDS

John Brandt Memorial Scholarship ($25,000) 2025–2026
Awarded to outstanding graduate students advancing nutrition and food science research.

Mitsuko Inano Kellam Fund, Department of Nutritional Sciences ($5,000) 2023–2024
Supports pre-dissertator research in the nutritional sciences.

Mary Shine Peterson Award, Department of Biochemistry ($5,000) 2021
Recognizes biochemistry undergraduates with demonstrated excellence in and commitment to research.

Mitsuko Inano Kellam Fund, Department of Nutritional Sciences ($2,500) 2021–2022
Supports undergraduate research in the nutritional sciences during senior year.

UW–Madison Undergraduate Scholarship for Summer Study ($1,000) 2021
Supports high-achieving undergraduates attending Summer Term at UW–Madison.

Biology Core Curriculum Honors Certificate 2021
Recognizes excellence across a four-semester honors lecture and laboratory sequence in cell biology, physiology, genetics, evolution, and ecology.

Dean's List 2018–2022
Special recognition for superior scholarship.

GRADUATE MACHINE LEARNING COURSEWORK

CS 7641 – Machine Learning (Georgia Tech)

- Benchmarked decision trees, k-NN, SVM, and scikit-learn and PyTorch MLPs on the imbalanced (~103×) UCI Forest Cover Type task under a leakage-safe cross-validation protocol; the PyTorch MLP performed best (0.816 accuracy, 0.710 balanced accuracy, 0.704 macro-F1).
- Ran controlled optimization studies on a fixed PyTorch network: randomized optimization (RHC, SA, GA) vs. gradient training, Adam-family ablations (1.5–3× fewer gradient evaluations to reach SGD's validation loss), and regularization ablations exposing minority-class collapse.
- Analyzed unsupervised structure with k-Means, Gaussian mixtures, PCA, ICA, and random projection, showing that dimensionality reduction cut downstream balanced accuracy (0.710 → 0.644–0.658) by discarding sparse features that separate rare classes.

CSE 6250 – Big Data for Healthcare (Georgia Tech)

- Applied machine learning to EHR-style datasets for disease prediction and risk stratification.
- Developed preprocessing and feature extraction pipelines for large-scale clinical data.
- Implemented classification models and evaluated them with AUC, precision–recall, and cross-validation.

CS 7646 – Machine Learning for Trading (Georgia Tech)

- Built predictive models for financial time-series data using regression and reinforcement learning.
- Implemented portfolio optimization and trading strategies with feature engineering and backtesting pipelines.
- Designed end-to-end data pipelines with NumPy, Pandas, and model evaluation systems.

CS 760 – Machine Learning (UW–Madison)
- Implemented decision trees, k-nearest neighbors, logistic regression, and ensemble methods from scratch in Python.
- Conducted bias–variance analysis and model evaluation with cross-validation and performance metrics.
- Studied theoretical foundations of learning, including VC dimension, generalization bounds, and optimization.

BMI 776 – Advanced Bioinformatics (UW–Madison)
- Analyzed high-dimensional biomedical datasets with statistical and machine learning methods.
- Applied dimensionality reduction and clustering to biological data.
- Developed reproducible Python and R workflows for translational biomedical applications.

TEACHING AND MENTORING EXPERIENCE

Graduate Teaching Assistant September 2023 – December 2023
Nutrition Today, Department of Nutritional Sciences, University of Wisconsin–Madison
- Led lectures for up to 500 undergraduate students, distilling complex nutrition concepts into accessible, engaging content.
- Organized and facilitated review sessions using interactive discussions and targeted exercises.
- Collaborated with faculty on curriculum design and teaching materials.
- Created and maintained course resources, including study guides and supplemental materials.

Undergraduate Teaching Assistant September 2021 – May 2022
Nutrition Today (First-Year Interest Group), Department of Nutritional Sciences, University of Wisconsin–Madison
- Contributed to course materials for 500+ non-biology majors, ensuring accessibility for a diverse audience.
- Organized and facilitated learning communities to encourage active learning and collaboration.
- Designed and coordinated final projects applying nutrition concepts to students' personal and professional lives.
- Led biweekly teaching team meetings to align on strategies and course objectives.

First-Year Interest Group Facilitator September 2021 – May 2022
Food and Culture Aspects of Nutrition, Department of Nutritional Sciences, University of Wisconsin–Madison
- Led weekly small-group discussions on nutrition, food, and cultural identity.
- Developed discussion materials integrating content from a cluster of three courses.
- Created an inclusive, supportive environment that helped incoming first-year students transition to college.

Academic Tutor February 2019 – January 2022
Division of Intercollegiate Athletics, University of Wisconsin–Madison
- Developed customized lesson plans for student-athletes in physics, nutrition, and chemistry.
- Tutored student-athletes 10 hours per week in exam preparation and core course concepts.
- Guided students to deepen understanding through concept elaboration and practice problems.

Honors Program Peer Advisor and Peer Mentor September 2020 – May 2022
Biology Core Curriculum Program, University of Wisconsin–Madison
- Advised students on four-year academic plans and personal goals during orientation sessions.
- Served as an ongoing academic resource for incoming students.
- Led weekly mentoring sessions for a small group in introductory biology courses.
- Developed learning materials, including key concepts and practice questions.

Buddies Program Mentor May 2021 – September 2021
Biology Core Curriculum Program, University of Wisconsin–Madison
- Held monthly summer meetings advising a group of 10 students before they joined the honors program.
- Created meeting materials and interactive Kahoot games for each session.
- Wrote reflective essays on the strengths and weaknesses of each session.

Language Tutor February 2019 – May 2021
Greater University Tutoring Service (GUTS), University of Wisconsin–Madison
- Tailored tutoring methods to individual students learning Chinese.
- Assisted with coursework and test-taking strategies to improve exam performance.
- Prepared students for presentations and oral exams, focusing on language proficiency and communication.