Anherutowa Calvo

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Objective

Seeking a research-focused role combining machine learning and computational molecular dynamics to study complex biomolecular systems. Passionate about developing scalable algorithms, hybrid ML–physics models, and HPC simulations to accelerate discoveries in drug design, vaccine development, and synthetic biology.

Education

- **Princton University** *August 2023 - May 2027*
  Chemical and Biological Engineering; Minors in Statistics & Machine Learning, Computational Biology Princeton, New Jersey
  - GPA: 3.82/4.00

Experience

- **Pfizer Inc. [🌐]** *May 2025 - Present*
  Research and Development Intern Pearl River, New York
  - Fine-tuning large (protein) language models on pathogen-specific spike protein datasets to enhance downstream applications.
  - Investigating catastrophic forgetting and generalization trade-offs in fine-tuned pLMs, optimizing training regimes and evaluation strategies on real-world virological datasets.
  - Designing and interpreting machine learning experiments to quantify how adapted pLMs improve predictive accuracy on various benchmarking tests.
- **Joseph Research Group [🌐]** *March 2025 - Present*
  Student Researcher Princeton, New Jersey
  - Developing molecular dynamics and coarse-grained simulations to model biomolecular condensates, investigating protein-RNA interactions and phase separation mechanisms in neurodegenerative diseases and cancer.
  - Applying statistical physics and thermodynamic models (e.g., Flory-Huggins theory, Lennard-Jones potential) to predict phase behavior and identify druggable condensates for pharmaceutical applications.
  - Integrating machine learning for predictive modeling of phase separation and screened small molecules targeting pathological condensates in ALS, cancer, and viral infections.
- **Conway Research Group [🌐]** *April 2024 - Present*
  Student Researcher Princeton, New Jersey
  - Investigated sugar degradation pathways in *Caldicellulosiruptor bescii*, focusing on the role of carbohydrate transporters and hydrolytic enzymes in biomass conversion.
  - Conducted growth assays of genetically modified C. bescii strains, evaluating their ability to utilize lignocellulosic substrates under thermophilic anaerobic conditions.
  - Designed genome editing experiments using electroporation-based transformation, introducing targeted deletions in sugar transport genes to study metabolic effects.
- **Stanford University[🌐]** *June 2025 - August 2025*
  ML/AI Biomedical Intern Remote
  - Implemented an end-to-end medical imaging pipeline that learned robust representations from unlabeled optical frames via contrastive/self-supervised pretraining and CLIP-style image–metadata alignment.
  - Fine-tuned ViT/UNet for classification and segmentation tasks with calibrated, uncertainty-aware outputs, deploying models efficiently with ONNX/AMP.
- **Vault Technology LLC [🌐]** *December 2025 - Present*
  Fullstack Developer Remote
  - Developed an interactive dashboard for real-time financial analytics, improving user engagement metrics by 25%.
  - Conducted API integrations with third-party payment gateways, ensuring compliance with PCI-DSS standards.
  - Designed and implemented a secure authentication system for a fintech web platform, integrating OAuth 2.0 for enhanced security and scalability.
- **Merck & Co. [🌐]** *December 2025 - February 2025*
  ML/AI Winter Intern Rahway, New Jersey
  - Developed a forecasting model for varicella vaccine demand, analyzing historical epidemiological trends and vaccination rates to optimize immunization strategies.
  - Conducted formulation evaluations for pediatric vaccines, ensuring stability and efficacy under diverse temperature and storage conditions.
  - Collaborated with global public health experts to refine vaccine distribution frameworks, considering regional variations in access, coverage, and immunogenicity.

- **National Institute of Health [🌐]** *August 2024 - October 2024*
  Epidemiology and Public Health Intern Mangilao, Guam
  - Collaborated with global public health experts to refine vaccine distribution frameworks, considering regional variations in access, coverage, and immunogenicity.
  - Worked closely with data scientists and healthcare professionals to visualize trends in disease prevalence, supporting evidence-based policy recommendations.
  - Developed the Guam Health Initiative Survey, a full-stack health data platform using MongoDB, HTML, CSS, and JavaScript, ensuring user-friendly access to public health records.
- **Johns Hopkins University [🌐]** *July 2024 - October 2024*
  ML/AI Biomedical Research Intern Baltimore, Maryland
  - Developed an AI-powered diagnostic tool using Convolutional Neural Networks (CNNs) for breast cancer detection, training models on mammogram and MRI datasets.
  - Engineered a data preprocessing pipeline, incorporating noise reduction, normalization, and augmentation to enhance classification accuracy and generalization.
  - Applied deep learning techniques to automate tumor segmentation, reducing manual review time by 40
- **Andlinger Center for Energy + Environment [🌐]** *May 2024 - August 2024*
  Bioengineering Intern Princeton, New Jersey
  - Engineered thermophilic lignocellulose-degrading bacteria to enhance biofuel production, optimizing pathways for biomass saccharification.
  - Conducted metabolomic and proteomic analyses to characterize biofuel precursors, refining bioconversion processes for commercial applications.

PROJECTS

- **Protein Language Model–Driven Condensate Profiling *(Joseph Lab, Junior Paper)*** *Ongoing*
  Methods: Pretraining, Training, Fine-tuning, Distributional Prediction, Cross-Entropy + Smoothness Regularization
  - Developed ML pipeline using pretrained protein language models to predict condensate density profiles of intrinsically disordered proteins.
  - Benchmarked against baselines (composition features, Random Forest, XGBoost, etc.), showing specific pLMs substantially improves R^2 for mean and variance radial distributions.
  - Implemented two-stage fine-tuning (frozen backbone $\rightarrow$ selective unfreezing) with cross-entropy + total-variation loss to enforce smoothness and probabilistic accuracy.
- **Hybrid Physics–ML Condensate Modeling *(Joseph Lab, Junior Paper)*** *Ongoing*
  Methods: Coarse-grained MD (Mpipi), ML Prediction
  - Simulating intrinsically disordered proteins to map phase diagrams of biomolecular condensates.
  - Integrating statistical mechanics models with ML predictors to prioritize small-molecule modulators of pathological condensates.
- **Transporter–Ligand Structural Modeling *(Conway Lab)*** *Ongoing*
  Methods: Templated-AlphaFold2, Rosetta docking
  - Modeled carbohydrate transporters in *C. bescii*, docking oligosaccharides and refining poses with pyMol.
  - Measured binding pocket volume/charge (FPocket/APBS) and correlated docking predictions with experimental growth assays.
- **Bionics: Artificial Heart** *Ongoing*
  Tools: Arduino, Raspberry Pi, MATLAB, COMSOL, Biomaterials, 3D Bioprinting
  - Began developing a biomechanical artificial heart model for hemodynamic analysis.
  - Implemented fluid dynamics simulations, optimizing cardiac output.
- **Vaccine Mutation Embedding Trajectory Prediction *(Pfizer, internal)*** *August 2025*
  Methods: Protein LLM embeddings, trajectory simulation, antigenic drift forecasting
  - Used high-dimensional protein embeddings to simulate and forecast antigenic drift trajectories, supporting vaccine strain selection pipelines.
  - Developed evaluation harnesses for cosine/Euclidean similarity metrics, UMAP projections, and clade-aware filtering.
  - Incorporated into Pfizer internal manuscript (under NDA).
- **Segmental Hash-Guided Alignment (SHGA) *(Pfizer, internal)*** *August 2025*
  Methods: $O(n \log n)$ alignment, k-mer hashing, parallel similarity search
  - Designed a novel segmental alignment algorithm reducing runtime from **days to hours** for 150k+ protein corpora with accuracy parity to Needleman–Wunsch.
  - Implemented chunked I/O, Numba JIT acceleration, and joblib-based distributed evaluation.
  - Incorporated into Pfizer internal manuscript (under NDA).

- **Optimized Modeling of ESM2 (Multi-Encoder for N/C-terminal embeddings) *(Pfizer, internal)*** *August 2025*
  Methods: Contrastive learning, dual encoders, CLIP-style projectors
  - Extended sequence coverage beyond the 1024-token limit by aligning N- and C-terminal encoders with a joint embedding space.
  - Built projection heads and benchmarking suite, improving spike protein downstream predictions.
  - Incorporated into Pfizer internal manuscript (under NDA).
- **Bionics: Myoelectric Prosthetic Hand** *Aug 2024 – May 2025*
  Tools: Arduino, Raspberry Pi, EMG Sensors, Python, 3D Printing
  - Designed a prosthetic hand responsive to electromyographic (EMG) signals.
  - Developed ML algorithms for gesture recognition and adaptive grip control, improving dexterity for real-world use.
- **Comparative Analysis of C. bescii and T. kivui** *Dec 2024 – May 2025*
  Tools: Python, Linux, AlphaFold 3, BLAST, Rosetta
  - Conducted structural and metabolic comparisons between thermophilic and acetogenic pathways to optimize biofuel production strategies.
  - Utilized AlphaFold 3 for protein structure predictions, analyzing key enzymatic differences in sugar metabolism.

PUBLICATIONS/CONTRIBUTIONS

C=CONFERENCE, I=IN-CREATION, J=JOURNAL, P=POSTER, S=IN SUBMISSION

[S.1] Hansen Tjo, Virginia Jiang, **Anherutowa Calvo**, Jerelle A. Joseph, Jonathan M. Conway, et al. (2025). **Genetic and biophysical insights to the uptake of lignocellulose-derived carbohydrates by the extreme thermophile *Anaerocellum bescii***. *American Society for Microbiology*.

[C.1] Hansen Tjo, **Anherutowa Calvo**, Kelly Blundin, Jonathan M. Conway, et al. (2025). **A Highly Conserved ABC Transporter Drives Cellulose Utilization in the Extremely Thermophilic, Lignocellulosic Bacterium *Anaerocellum (f. Caldicellulosiruptor) bescii***. To be presented at *the 47th Symposium of Biomaterials, Fuels, and Chemicals*.

[C.2] Hansen Tjo, **Anherutowa Calvo**, Kelly Blundin, Jonathan M. Conway. (2025). **Fundamentals and Engineering of Sugar Transport in Lignocellulose-Degrading Thermophiles**. Accepted abstract, *AIChE Annual Meeting, Food, Pharmaceutical & Bioengineering Division*.

[C.3] Hansen Tjo, **Anherutowa Calvo**, Kelly Blundin, Jonathan M. Conway. (2025). **Sugar Transport and Metabolic Control in the Lignocellulose-Degrading, Extremely Thermophilic Bacterium *Anaerocellum bescii***. Accepted abstract, *Synthetic Biology: Engineering, Evolution, & Design (SEED)*.

[C.4] Hansen Tjo, **Anherutowa Calvo**, Virginia Jiang, Jerelle A. Joseph, Jonathan M. Conway, et al. (2024). **Harnessing Extremely Thermophilic Bacteria to Solve the World's Energy and Environmental Challenges**. In *the International Sustainability Forum*. Energy Academy Indonesia.

[P.1] **Anherutowa Calvo**, Hansen Tjo, Jonathan M. Conway, et al. (2024). **Engineering Extremely Thermophilic Cellulolytic Organisms and Enzymes for Biofuel Production**. Poster presented at *the Annual Andlinger Meeting*.

[P.2] **Anherutowa Calvo**, Ryan Miner, Joy Kogah, Alexis Korzan, et al. (2024). **The Effects of UspA UP Element 326x Promoter Sequence in RFP Expression compared to UspA Original Promoter Sequence in *E. coli* Nissle 1917**. Poster presented at *the Department of Molecular Biology FSI Research Conference*.

[P.3] Hansen Tjo, Kelly Blundin, **Anherutowa Calvo**. (2025). **Harnessing a Thermophile's Sweet Tooth to Power the Future**. Presented at *Princeton Research Day*.

SKILLS

- **Programming Languages:** Python, Java, MATLAB, Linux, LaTeX, HTML/CSS/JavaScript
- **Data Science & Machine Learning:** PyTorch, TensorFlow, HuggingFace, scikit-learn, NumPy, Pandas, xFormers
- **Bioinformatics & Modeling:** AlphaFold, Rosetta, BLAST, PyMOL, Chimera; MD & coarse-grained simulations
- **Specialties:** LLM fine-tuning, pre-/post-training, domain adaptation, prompt engineering, evaluation pipelines, benchmarking
- **Research Skills:** Genome Engineering, RNA-seq Analysis, Protein Structure Prediction, Metabolic Modeling, Wet Lab Techniques (PCR, Cloning, Cell Culture)
- **Extra:** Competitive Hotpot Eating, Skateboarding

Honors and Awards

- **Google Best Poster Award – Andlinger Center Energy & Environment Conference** *2024*
  Princeton University (Sponsored by Google) [🌐]
  ◦ Recognized for excellence in research on bioengineering and renewable energy solutions.
- **The Gates Scholarship** *2023*
  Bill and Melinda Gates Foundation [🌐]
  ◦ Highly selective full-ride scholarship awarded to exceptional minority students demonstrating leadership, academic excellence, and community service.
- **Hispanic Scholarship Fund Scholar** *2023*
  Hispanic Scholarship Fund [🌐]
  ◦ National scholarship awarded to outstanding students with strong academic performance, leadership, and commitment to serving their communities.
- **CoreTech Scholarship Recipient** *2023*
  CoreTech Foundation [🌐]
  ◦ Awarded to students demonstrating exceptional potential in technology and engineering, with emphasis on innovation and problem-solving.
- **QuestBridge National College Match Scholar** *2023*
  QuestBridge [🌐]
  ◦ Full four-year scholarship awarded to outstanding low-income students attending top-tier universities.

Leadership Experience

- **Founder and Lead – Bionics Team** *2024 - Present*
  Princeton University Robotics, sponsored by NVIDIA [🌐]
  ◦ Led a multidisciplinary team developing a biomedical equipment,integrating AI-based motion recognition.
  ◦ Conducted research on machine learning models to optimize prosthetic hand/heart control and responsiveness.
  ◦ Organized outreach programs to promote assistive technology innovation in biomedical engineering.
- **Eco Representative Leader** *2023 - Present*
  Princeton University Office of Sustainability [🌐]
  ◦ Led campus-wide initiatives promoting sustainability and reducing energy consumption.
  ◦ Designed and implemented programs to engage students in environmentally responsible behaviors.
- **Advisor to the Governor of Guam** *2021 - 2023*
  Government of Guam [🌐]
  ◦ Provided policy recommendations on STEM education and public health initiatives.
  ◦ Assisted in the implementation of youth-led community projects for environmental sustainability.

Volunteer Experience

- **Princeton University Blood Drive** *2023 – Present*
  Princeton University Health Services [🌐]
  ◦ Coordinated and assisted in blood donation events, educating students on the importance of blood donation.
- **American Red Cross** *2022 – Present*
  American Red Cross [🌐]
  ◦ Assisted in disaster relief efforts, emergency preparedness, and health education programs.
  ◦ Provided logistical support for emergency response operations and blood donation campaigns.

Certifications

- **Princeton EHS Fundamentals of Laboratory Safety** *2024*
- **CITI Office of Research and Sponsored Programs** *2024*
- **CITI Social-Behavioral-Educational Researchers** *2024*
- **Python for Data Science and Machine Learning** *2024*
- **ACT Platinum National Career Readiness** *2023*

Additional Information

Languages: English (Advanced), Japanese (Intermediate), CHamoru (Intermediate)
Interests: Vaccine Research and Development, Drug Research and Discovery, Machine Learning, Genome Engineering, Molecular Dynamics