Shengnan Liu

6510 El Colegio Rd, Santa Barbara, CA, 93106 | shengnan_liu176@ucsb.edu | (805)-689-6456

Education: Graduate and Undergraduate

University of California, Santa Barbara (UCSB)   Santa Barbara, California
Major: *Master of Science in Computer Science* | **Cumulative GPA:** 3.75/4.00   *Sep. 2024 - June, 2026 (Expected)*
Relevant Courses: Artificial Intelligence, Reinforcement Learning, Quantum Computing, Security in Machine Learning and Post-Quantum Cryptography, Combinatorial Algorithms, Software Foundations, Computational Geometry, Graph Theory, Graph Neural Networks, Computer Graphics
Personal Webpage: https://dolloading906.github.io/My-Personal-Webpage/

University of California, Santa Barbara (UCSB)   Santa Barbara, California
Major: *Bachelor of Science in Mathematics* | **Cumulative GPA:** 3.76/4.00   *Sep. 2020 - June, 2024*
Minors： Statistics and Data Science; Spatial Science
Honor: UCSB College of Letters & Science Dean's Honors during Spring 2024, Winter 2024, Fall 2023, Fall 2022, Spring 2021, Winter 2021 Quarters
Relevant Courses: Linear Algebra, Abstract Algebra, Real and Complex Analysis, Linear and Non-linear Optimization, Graph Theory, Topology, Differential Geometry, Euclidean and Non-Euclidean Geometry, Number Theory, Data Structure, Data Management, Web Design, Linear Regression, Statistical Machine Learning, Stochastic Process, Remote Sensing

Skills

- **Programming Languages:** Python, JavaScript, Java, C++, C, SQL, R, MATLAB
- **Frameworks:** React, Node.js, Flask, FastAPI, Express
- **Tools & Platforms:** GitHub, VS Code, Git, Figma, PyCharm Community, Anaconda, API Gateway, R-Studio, MySQL, Jupyter Notebook, QGIS, Overleaf, MATLAB, Microsoft Excel, Microsoft Word, Microsoft PowerPoint

Research Experience

Extending Online Policy Optimization Algorithm to Manifolds (Individual Research) Santa Barbara, California, USA
Instructor: James Preiss, Assistant Professor at UCSB   *March, 2025 – June, 2026 (Expected)*

- (In progress) Developing a differential-geometric theoretical framework for M-GAPS, adapting and extending assumptions and results from two prior lines of work on online policy optimization and contractive perturbations, and introducing new results where necessary
- Derived a standalone Memoryless Gradient-based Adaptive Policy Selection (M-GAPS) (known-model, no residuals/perturbations) by isolating the policy-update mechanics from two prior frameworks, *"Online Policy Optimization in Unknown Nonlinear Systems"* and *"Online Adaptive Policy Selection in Time-Varying Systems No-Regret via Contractive Perturbations,"* achieving $O(1)$ memory with local-regret comparable to GAPS in **Overleaf**
- Structured a comprehensive differential geometry document for educational purposes and for extending M-GAPS to manifolds in **Overleaf**
- Connected with authors from two prior frameworks to discuss potential typos and issues in those papers

Research on *Geometric Algebra Transformer* (GATr) for Symmetry-Preserving Computations (Individual Research)
Santa Barbara, California, USA
Instructor: James Preiss, Assistant Professor at UCSB   *January, 2025 – March, 2025*

- Conducted an in-depth investigation into the Geometric Algebra Transformer (GATr), exploring its theoretical foundations and architectural innovations for geometric data representation and symmetry preservation in neural models
- Analyzed and highlighted the efficiency and robust generalization properties of GATr, demonstrating superior performance compared to conventional methods (e.g., SE(3)-Transformers, Graph Neural Networks) in handling symmetry through equivariance with respect to the E(3) group
- Explored practical implications of GATr in dynamic and unstructured environments, particularly in robotics and molecular modeling, emphasizing the significance of maintaining geometric consistency through translation, rotation, and reflection invariances
- Provided detailed mathematical exposition on geometric algebra concepts, including Clifford algebra, equivariance properties, and projective geometric algebra representations
- A 31-page research report paper was written to condense the above investigation

Research on the Minimum Label Spanning Tree Problem (Group Research)   Santa Barbara, California, USA
Instructor: Subhash Suri, Distinguished Professor at UCSB   *October, 2024 – December, 2024*

- Deeply analyzed 2 heuristics solutions, including a logarithmic performance-guaranteed algorithm, for approximating NP-hard MLST solutions
- Proved NP-hardness of MLST problems via reduction and established performance bounds for efficient solutions
- Leveraged Union-Find structures, integer linear programming, etc. for optimized spanning tree construction
- Wrote a 15-page research report paper to condense the above investigation

Research on Infinite Sets and the Axiom of Choice (Group Research)   Santa Barbara, California, USA
Instructor: Geunho Lim, Former Visiting Assistant Professor at UCSB   *April, 2023 – June, 2023*
- Wrote an 10-page individual mathematical paper introducing infinite sets and the axiom of choice, proving theorems and lemmas, constructing applications based on them, and generating reflections
- Filmed a 90-minite video with group members: went over proofs, explained the importance of the axiom of choice and offered examples, applications, and reflections under the context of both the mathematical world and the real life
- Organized group discussions and meetings

Teaching & Mentorship

Reader / Grader, CS130B: Data Structures and Algorithms II — UCSB, Spring 2025   Santa Barbara, California, USA
Instructor: Ambuj Kumar Singh, Distinguished Professor at UCSB   *March, 2025 – June, 2025*
- Graded ~75 theory/algorithm assignments weekly (paper-based), applying rubric-aligned evaluation for correctness, rigor, and asymptotic analysis
- Graded ~75 programming assignments bi-weekly on UCSB Kattis, assessing correctness, edge-case handling, and time/space complexity
- Delivered individualized, 1:1 written feedback via Gradescope to help students understand mistakes and improve

Project Experience

"ezLoop"- Mobile App Development (Ongoing Group Project)   *September, 2024 – Current*
- Designed UI/UX in **Figma** for Settings, Product Detail, Saved Collection, Login, and Checkout; built component variants, defined the icon library, and exported assets for hand-off
- Implemented front-end pages in **React Native** (**Expo**) using **VS Code**, writing **JavaScript** and **JSON** configs for navigation/routes and screen states; added a small JSI-based **C++** native module to offload compute-heavy utilities used by Product Detail/Saved screens
- Polished layouts by standardizing spacing/typography, aligning colors and iconography to **Figma**, and fixing iOS breakpoint/layout bugs
- Integrated Firebase Auth (email/password) for sign-up/sign-in and session persistence
- Built **Firestore** data layer with real-time listeners and queries; modeled collections for users, products, carts, and saved items to enable live updates across screens
- Implemented product-management APIs and flows (create/read/update/delete, listing, search/sort) and synchronized UI with **Firestore** with payload validation and robust loading/error states
- Localized the UI with i18next (English/Chinese), externalizing strings to **JSON** and auto-selecting language based on device settings
- Collaborated with an 8-member cross-university team via **Git/GitHub** (branching, pull requests, code reviews) and lightweight Agile sprints to plan features and track progress
- Goal: enable international students in North America to buy and sell second-hand furniture and daily necessities

Quantifying Representation Learning with Large Language Models for Recommendation (Group Project)
Santa Barbara, California, USA
Instructor: Tao Yang, Professor at UCSB   September, 2025 – December, 2025
- Reproduced and extended RLMRec, a WWW'24 framework that injects LLM semantics into collaborative filtering, on three datasets (Amazon-book, Yelp, Steam) and multiple graph-based backbones, including GCCF, LightGCN, SGL, SimGCL, AutoCF and related variants.
- Implemented an end-to-end training and evaluation pipeline in **Python** within a **Miniconda** environment, launched and managed via the **Windows command line**, including configuration management, logging, checkpointing, and Recall@K / NDCG@K ranking evaluation, while keeping the inference-time footprint identical to the backbone models.
- Built a semantic analysis toolkit to quantify alignment between ID embeddings and LLM-based text embeddings using neighbor-overlap Jaccard similarity, alignment-trend curves, step histograms, and UMAP visualizations.
- Demonstrated that contrastive alignment improves Jaccard overlap with text-derived semantic references by about 40% on average across settings, without increasing online latency.
- Took ownership of full-scale training experiments and final communication: configured and launched all RLMRec runs across the full grid of datasets, backbones, and alignment settings, adapting scripts and configuration files, tracking progress and resolving data/configuration issues, aggregating metrics into final result tables and plots, drafting the initial presentation and anticipated Q&A material, and coordinating cross-review of code, logs, figures, and writing with teammates.

Statistical Machine Learning (Individual Project)   Santa Barbara, California, USA
Instructor: Katie Coburn, Lecturer at UCSB   *October, 2023 – December, 2023*
- Chose Kaggle's Spaceship Titanic Dataset, a twist on the classic Titanic competition, and decided the topic of prediction: which passengers on the ship went missing after the ship's collision
- Conducted exploratory data analysis (EDA), data cleaning, and feature engineering in **R-Studio**
- Applied machine learning knowledge, including but not limited to classification and regression training, to develop models, such as random forest and gradient boosting machine, to predict which passengers were missing in **R-Studio**

Biometric Indicators of Heart Failure (Group Project)_   Santa Barbara, California, USA
Instructor: Saad Mouti, Visiting Assistant Professor at UCSB   *April, 2023 – June, 2023*
- Analyzed the dataset, visualized the distributions of variables in the dataset, and selected variables of interest for further statistical analysis in **R-Studio**
- Built simple linear regression model and conducted hypotheses testing as well as t-test in **R-Studio**
- Built multiple linear regression model, conducted F-test, and derived confidence and prediction intervals in **R-Studio**
- Performed Lasso and Ridge regression to test for collinearity between predictors in **R-Studio**
- Performed weighted least squares method to explore whether a model with a higher explainability could be built in **R-Studio**

Geometry Investigation (Group Project)   Santa Barbara, California, USA
Instructor: Nathan Schley, Lecturer at UCSB   *November, 2023 – December, 2023*
- Investigated whether Side-Angle-Side Congruence (SAS) and Angle-Side-Angle Congruence (ASA) for triangles in Euclidean Geometry remain true for triangles in Non-Euclidean Geometry, including spherical and elliptic geometry
- Presented the findings and results, including but not limited to the proof that shows SAS holds in spherical geometry but fails in cylinder and circular cone geometry, and the analysis that shows the fundamental cause of such a difference

Web Mapping (Individual Project)   Santa Barbara, California, USA
Instructor: Vena Chu, Vice Chair of Undergraduate Programs at UCSB   *November, 2022 – December, 2022*
- Applied **R-Studio**, **Github**, and **Excel** to create a dataset and a website page of a custom online world map introducing six specific amazing places with images and texts, including the beautiful UCSB campus

Map Blog Post (Individual Project)   Santa Barbara, California, USA
Instructor: Vena Chu, Vice Chair of Undergraduate Programs at UCSB   *November, 2022 – December, 2022*
- Applied **QGIS** and standard map format to process and evaluate "World Map of Sports Popularity Based by Region"
- Wrote a report to summarize the merits and deficiency of "World Map of Sports Popularity Based by Region" and extend to general map making

Work Experience

EVE Energy Co., Ltd.   Huizhou, Guangdong, China
Analyst in Lean Lab, Engineer in Quality Research Office   *July, 10th, 2023 – Sep., 12th, 2023*
- Learnt data collection on factory machines, built corresponding data frames and analyzed the data in **R-Studio**
- Calculated the premium product yield rate and "monetary yield rate" in **Excel** to report whether each factory is in profit or loss based on given computing algorithm and datasets
- Developed a more accurate algorithm for "monetary yield rate" to more precisely assess factory performances
- Applied **Excel** formulas to calculate "continuous excellence date" of all manufacturing processes and used **Python** to obtain the distribution of product deficiency amounts to report which processes need specialized improvements
- Applied **Excel** formulas to determine the existence of error in data transformation across different documents
- Repaired broken **Excel** forms so that future data can be more precisely and efficiently recorded and analyzed
- Participated in the optimization of Work In Process (WIP) management by offering theoretical algorithms and analysis
- Analyzed and optimized the raw material claiming rules using **Python**
- Communicated with employees from factories and financial department to avoid data falsification and discrepancies
- Fixed miswording, format and printing errors, and English authenticity issue of signage inside various factories
- Assisted working group members by recording information while they are busy with communicating with factory employees or by offering reminders and suggestions
- Learnt cell fundamentals and the entire production process by both impartment and in person visits
- Offered suggestions regarding the 5S approach used in factories and the lean lab
- Offered suggestions on Excel form standardization, intact database construction, and corresponding data analysis

Volunteer Experience

Math Motivators- A Program of The Actuarial Foundation   Illinois, USA
Volunteer Tutor   *January, 2022 – June, 2024*
- Attended remote sessions to tutor students varying from high schools to primary schools regarding algebra, geometry, calculus, statistics, and other relevant topics by explaining concepts, answering questions on homework, and offering exam preparation advice
- Attended remote sessions to tutor students from high schools to assist their SAT test preparation

UCSB Math Tutors   Santa Barbara, California, USA
Volunteer Tutor   *January, 2022 – June, 2024*
- Assisted Gauchos (individuals from UCSB) who need tutoring in UCSB math courses which I have taken and succeeded by explaining concepts, answering questions on homework, and offering exam preparation advice