

Callie C. Liao

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EDUCATION

McLean High School

McLean, VA

Aug. 2021-Jun. 2025

High school GPA: 3.96/4.0 (unweighted), 4.62/5.0 (weighted)

10 AP's (up to 11th), 15 APs total, 6 post-AP/dual enrollment courses

Stanford University

Stanford, CA

Jun. 2023-Aug. 2023

Selected pre-college student while in 10th grade

(for college credit)

Two A's in college CS & Math in-person courses with undergraduate/graduate students

MATH & COMPUTER SCIENCE COURSES TAKEN – All A's

	Taken in High School	Taken in College
Math	AP Calculus BC AP Statistics PreCalculus w/Trig HN Multivariable Calculus & Linear Algebra Advanced (AV)	Stanford University: Summer 2023: MS&E20 - Discrete Probability Concepts & Models George Mason University (GMU): Fall 2024: Elementary Differential Equations Spring 2025: Advanced Differential Equations
Computer Science (CS)	AP Computer Science A AP Computer Science Principles Dual Enrollment (DE): Discrete Structures & Computer Organization	Stanford University: Summer 2023: CS106B - Programming Abstractions GMU (online, audited): Introduction to Natural Language Processing (NLP) NLP with Deep Learning Applied Machine Learning Big Data Analytics

RESEARCH SKILLS

Artificial Intelligence (AI), Generative AI, Multimodal AI

Machine Learning, Deep Learning, Data Science

Natural Language Processing (NLP), AI for Music

Robotics, Unmanned Aerial Vehicles (UAV)

TECHNICAL SKILLS

Operating Systems

Windows, Mac OS, Linux

General Programming

Python, C/C++, Java, Assembly, R, JavaScript, HTML/CSS

IDEs

JupyterLab, Visual Studio Code, Google Colab

ML, Data Science/Big Data

Scikit-learn, SQL/NoSQL, MongoDB, PySpark, Databricks

NLP

NLTK, spaCy, Gensim, etc.

Deep Learning

PyTorch, TensorFlow, Keras

Robotics

VEXcode Pro V5, drones, VEX parts (strong engineering, analytics, and logic skills)

2D/3D Graphics/CAD

Photoshop, Blender, Autodesk Fusion 360, Procreate, Lucidchart

VR/AR Devices

UltraLeap/LeapMotion, Microsoft HoloLens, head-mounted VR devices, etc.

Research Writing Tools

Overleaf, LaTeX

SELECTED AWARDS/HONORS

Founder, President, and Varsity Team Captain of VEX Robotics Club	Sept. 2022-present
International Science & Engineering Fair (ISEF) Regional Science Fair Honorable Mention in Computer Science & Math	Mar. 2024
ISEF "Outstanding Engineer Award" and Prize by the Society of Women Engineers (SWE)	Mar. 2024
Youngest Professional Workshop Chair of IEEE Big Data 2023	Jun.-Dec. 2023
Founder of the 1st-ever AI Music Generation Workshop Worldwide	Jun.-Dec. 2023
1st Place and \$1000 Team Winner at MIX Drone Program	Nov. 2023
MIX Drone Program Microcredential	Nov. 2023
Youngest Northeast Robotics Colloquium (NERC) Participant at Yale University	Nov. 4, 2023
Harvard Science Research Conference Delegate at Harvard University (Global Top ~10%)	Oct. 21-22, 2023
American Regions Mathematics League (ARML) Contestant at Penn State University	Jun. 2022
President's Award for Educational Excellence (Middle School)	Jun. 2021
1st Place in Circuit Lab at Science Olympiad Middle School Regionals	Feb. 2020
- Advanced to States, but canceled due to COVID-19	
4th Place in Codebusters at Science Olympiad Middle School Regionals	Feb. 2020
- Advanced to States, but canceled due to COVID-19	
4th Place at the 2019 National Rhythmic Open Championships & Invitational	Jun. 2019
Quarterfinals Regionals Advancement in Middle School VEX Robotics	Feb. 2019
- Captain of a 1st-year all-6th-grade-girls team; beat the highest team in the middle school	
President's Award for Educational Excellence (Elementary School)	Jun. 2018

RESEARCH EXPERIENCE (3 Publications, 3 Under Review)

AI Music Research

Mar. 2022-present

Working on AI music generation research to emulate a human composer and developing novel algorithms and tools using core techniques such as multimodal AI, NLP, ML, and deep learning. More specifically, they are as follows:

- Lyrics-based AI song generation, time signature and key signature determination
- Multimodal representations, vector patterning, lyrics-rhythm matching
- Text information retrieval, audio information retrieval
- Keyword extraction, syllabication, sentiment analysis
- Audio alignment, feature generation, music analysis
- ML Model building (logistic regression, decision trees, random forest, XGBoost, LightGBM, etc.)
- Neural Network (NN) building (feed-forward NN, RNN, LSTM, GRU, etc.)
- Data balancing, data augmentation, web scraping

Key contributions:

- Proposed first pure algorithm-based, explainable, and trustworthy AI music generation
- Unveiled latent structure for new scores through textual information
- Built strong connections between lyrical and musical elements - groundwork for AI music generation
- Proposed the first-ever time signature determination method
- Avoided potential copyright infringement issues
- Created more reliable and responsible AI in the field of music generation
- Hosted the 1st-ever international workshop on AI music generation in 2023 worldwide
 - Increased AI music exposure, especially in STEM fields
 - Pioneered an interdisciplinary combination of NLP and music

International Science and Engineering Fair (ISEF)

Oct. 2023-Mar. 2024

Worked on time signature determination with lyrical sentiment analysis based on NLP & ML. Investigated whether adding a lyrical sentiment feature would improve the reliability of the determination method.

MIX Drone Program (~10% Acceptance Rate)

Sept. 2023-Nov. 2023

Worked on resolving crises from emergency first responders who are part of organizations such as FEMA, FBI, ARL (Army Research Laboratory), and the US Navy, particularly the treatment of post-wildfire air pollution levels using

Unmanned Aerial Vehicles (UAVs). Awarded \$1000 for presenting a professional team business pitch to judges from MITRE and Raytheon Technologies.

Northeast Robotics Colloquium (NERC) at Yale University

Nov. 4, 2023

Discussed improving generative music in ChatGPT and multimodal AI for human-robot interactions with professors, graduate students, and postdocs.

Harvard Science Research Conference (Global Top 10%)

Oct. 21-Oct. 22, 2023

Developed and presented a research project titled “Explainable Dengue Vaccine Prioritization using Machine Learning” regarding the dengue virus prevalent in Southeast Asia.

Medical Health Data Science Project

Dec. 2021-Jan. 2022

Worked on a spatiotemporal GIS project regarding cancer mortality using ML (e.g. KNN, k-means clustering, and DBSCAN) and visualization techniques (e.g. maps) with Python, sci-kit learn, Plotly, seaborn, matplotlib, etc.

PUBLICATIONS ([Google Scholar](#))

C. C. Liao, D. Liao, E. L. Zhang, and J. Guessford, “LyricAIR: A Pure Algorithm-Driven Framework for AI Song Generation Using Lyrics Only”, 25th International Society for Music Information Retrieval Conference (ISMIR 2024), San Francisco, USA, 2024. *(to be submitted)*

C. C. Liao and D. Liao, “Lyric-Sentiment-Based Time Signature and Key Signature Determination for AI Song Generation”, 25th International Society for Music Information Retrieval Conference (ISMIR 2024), San Francisco, USA, 2024. *(to be submitted)*

C. C. Liao, “Sentiment-Based Time Signature Determination for Original AI Music”, Conference on AI and Musical Creativity (AIMC 2024), University of Oxford, England, 2024. *(under review)*

C. C. Liao, D. Liao, and J. Guessford, “Automatic Time Signature Determination for New Scores Using Lyrics for Latent Rhythmic Structure”, 2023 IEEE International Conference on Big Data, Sorrento, Italy, 2023. *(long paper, oral presentation)* <https://doi.org/10.1109/BigData59044.2023.10386875>

C. C. Liao, “AI-Algorithmically-Generated Song with Lyrics”, 2023 IEEE International Conference on Big Data, Sorrento, Italy, 2023. *(poster)* <https://doi.org/10.1109/BigData59044.2023.10386887>

C. C. Liao and D. Liao (Editors), Workshop on AI Music Generation, 2023 IEEE International Conference on Big Data, Sorrento, Italy, 2023.

C. C. Liao, D. Liao, and J. Guessford, “Multimodal Lyrics-Rhythm Matching,” 2022 IEEE International Conference on Big Data, Osaka, Japan, 2022. *(long paper, oral presentation)* <https://doi.org/10.1109/BigData55660.2022.10021009>

C. C. Liao, “Thinking in 5D”, technical report, March 2018.

Non-Technical Publications:

C. C. Liao and Z. Liao, “My Alarm Clock is a Little Bird”, Journal of Music Education and Creativity, June 2016.

C. C. Liao and Z. Liao, “A Little Bird”, Journal of Children’s Music, vol. 345, pp. 40- 41, March 2015.

SELECTED HIGH SCHOOL EXTRACURRICULARS

School Clubs & Activities

Founder, President, and Varsity Team Captain of VEX Robotics Club

Sept. 2022-present

- Revived the club after 3 years of hiatus and tripled club enrollment
- Worked on every aspect (building, programming, tournament logistics, club outreach, ...)

AP Biology Oceanography Research in Marinelab, Key Largo, Florida

Mar. 21-24, 2024

- Collected organism samples underwater in seagrass and mangrove environments through snorkeling trips
- Contributed to citizen science projects (e.g. NOAA Marine Debris Program and NCCOS Phytoplankton Monitoring Network) through microplastics, phytoplankton, and special organism observations
- Performed several organism identification labs, including zooplankton identification

Science National Honor Society Member

Fall 2022-present

- Worked on research projects:
 - “Cryogenic Electron Microscopy for Cancer Prevention”
 - “Novel Treatments in Sickle Cell Anemia: Gene Therapy and Stem Cell Transplants”
- Aided younger children in setting up science experiments at a local elementary school
- Tutored freshmen who struggled with biology

Mu Alpha Theta (National Math Honor Society) Member *Fall 2023-present*
 - Tutored middle school students in mathematics

McLeadership Big Mac *Jun. 2023-Oct. 2023*
 - Selective mentoring program at McLean High School
 - Helped freshmen students become acquainted with the intensity of high school

McLean Highlander Math League (MHML) Selected Member *Aug. 2021-Oct. 2023*

Educational Excursions

Athens, Greece *Dec. 2023*
 - Gained a deeper understanding of ancient Greek culture and civilization
 - Started with zero Greek skills but could speak at an intermediate level by the end of the trip

Sorrento, Pompeii, and Rome, Italy *Dec. 2023*
 - Learned Italy's culture and Italian
 - Acquired a more thorough comprehension of Italy's history

Galápagos Islands, Ecuador *Jun. 2023*
 - Studied the biodiversity, history, and ecology of the archipelago
 - Gained a deeper understanding of the formation of Darwin's theory of evolution formed through real-life examples, specimens, and experiments
 - Observed equatorial physics experiments
 - Greatly improved Spanish speaking skills during the trip through daily conversations with locals

Music & Arts

Violinist, pianist, dancer, and artist.

Sports

High School Track & Field Junior Varsity Athlete *2022-present*

High School Freshman Girls Basketball Athlete *2021-2022*

Rhythmic Gymnastics *2014-2019*

- 4th Place at the 2019 National Rhythmic Open Championships & Invitational

Other Sports: *golf, swimming, volleyball, figure skating, and horseback riding*

Community Service

Workshop Chair of IEEE Big Data 2023 Artificial Intelligence Music Generation *Jun.-Dec. 2023*
 - Garnered attention worldwide, especially from top-tier communities, such as the International Society for Music Information Retrieval (ISMIR), Stanford CCRMA faculty, and AI for Musical Creativity.
 - Proposed and chaired the whole workshop program, organized the workshop committee, coordinated logistics with the main conference, invited and coordinated reviewers, reviewed research papers, developed the workshop website, invited keynote speakers, advertised the workshop, ensured that accepted papers adhered to the IEEE standards, responded to various inquiries from authors, arranged the program schedule in regards to international attendees' time zones, coordinated the hybrid workshop format at the in-person IEEE conference, and prepared potential questions to ask the presenters.
 - Attracted many in-person and online attendees during the workshop in Italy
 - 100+ hours for organizing the workshop

Personal YouTube Channel *Spring 2022-present*

Created educational science YouTube videos ("Passive Transport in a Cell Membrane Structure" and "How Do Hearing Aids Work? Bone and Air Conduction for the Ear").

HumScouts Tutor *Winter 2022-Spring 2023*

Tutored Title I elementary school students math weekly; organized lesson plans.

LANGUAGE SKILLS

English (*native*) **Chinese** (*native*) **Spanish** (*proficient*) **Greek** (*intermediate*) **Italian** (*Beginner*)