

# Sayema Lubis

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## EDUCATION

Harvey Mudd College – Claremont, CA  
B.S., Physics and Computer Science, Dean's List Distinction, 2024-2025

Expected May 2026

## RELEVANT COURSEWORK

Algorithm, Data Structures, Engineering Systems, Computational Physics, Digital Signal Processing, Quantum Mechanics, Thermodynamics, Theoretical Mechanics, Linear Algebra, Differential Equations (Upcoming: State Estimation, Computer Vision)

## CLINIC EXPERIENCE

### Embedded Systems Engineer, Mosaic Design Labs

Aug 2025 – Present

- Developing and testing STM32-based firmware for the MicroLab microfluidic automation system.
- Implementing I<sup>2</sup>C/SPI protocols for sensor and actuator communication to control CO<sub>2</sub> and pressure regulation.

## RESEARCH EXPERIENCE

### Music Information Retrieval Lab, Harvey Mudd College | *Department of Engineering*

June 2025 – Present

- Built a real-time accompaniment algorithm using a variant of Dynamic Time Warping (DTW) that adapts to live tempo fluctuations.
- Developed a real-time Time-Scale Modification (TSM) algorithm that reduced runtime by 40%, validated through a 25-participant perceptual study.
- First author of paper submitted to ICASSP 2026; released open-source implementation as a Python package.

### Physics of Soft Matter Lab, Harvey Mudd College | *Department of Physics*

June 2024 – January 2025

- Engineered a MATLAB control and analysis system integrating high-speed cameras and force sensors for viscoelastic recoil experiments.
- Applied computer vision and data processing to automate displacement tracking, improving data consistency and throughput.
- Collaborated in a multidisciplinary team of engineering, physics, and computer science students; held weekly meetings with research advisor to coordinate experiments and review findings.

## PROJECTS

### Real-Time Time Scale Modification | *Python, Numba, Signal Processing*

- Engineered a hybrid Overlap-Add/Phase Vocoder (OLA/PV) system with Harmonic-Percussive Separation (HPS) for real-time tempo manipulation.
- Built a low-latency buffering system enabling dynamic tempo control and continuous playback.
- Achieved >100× real-time performance with consistent high-fidelity audio output.

### Simulating Canonical Ensemble with Hamiltonian Monte Carlo (HMC) | *Julia, Parallel Computing*

- Implemented a parallelized HMC engine to simulate canonical ensemble systems, improving performance across high-dimensional parameter spaces.
- Validated thermodynamic behavior against theoretical expectations; leveraged multi-threaded Leapfrog integration for efficiency.

### Elastic Pendulum Simulation and Chaotic Dynamics | *Python*

- Modeled coupled spring-pendulum dynamics using Lagrangian mechanics and nondimensionalized parameters for generality.
- Simulated and visualized equilibrium, resonance, and chaotic regimes, identifying autoparametric resonance conditions.

### AI-Generated Piano Instrumentals | *Keras, LSTM Networks*

- Developed an LSTM-based music generator that produces piano compositions from MIDI input and illustrates machine learning fundamentals interactively.

## LEADERSHIP EXPERIENCE

### Committee for Activities Planning (CAP) Chair

August 2025 – Present

- Designed a budget of \$23K to organize 10+ events annually, increasing student engagement by 30%.

### NISSO Mentor, Office of Institutional Diversity

August 2025 – Present

- Mentored 32 international freshmen through orientation and transition to U.S. college life.

## TECHNICAL SKILLS

**Programming & Analysis:** Python, C/C++, MATLAB, Julia, Java

**Hardware & Tools:** STM32, Arduino, Git, Jupyter, NumPy, SciPy, Keras

**Domains:** Embedded Systems, Signal Processing, Computational Physics, Machine Learning