

# Xuyi (Sam) Ren

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## EDUCATION

### Grinnell College

Grinnell, IA

*Bachelor of Arts in Mathematics and Computer Science (Expected 2028)*

*Sep. 2024 – Present*

- GPA: 4.00 / 4.00
- Relevant Coursework: Calculus II, Functional Problem Solving, Linear Algebra (in progress), Applied Statistics (in progress)

### China World Academy

Suzhou, China

*International Baccalaureate Diploma Programme*

*2022 – 2024*

- Focused on Mathematics Analysis and Approaches (Higher Level) and Physics.

## RESEARCH EXPERIENCE

### Individual Research Projects

Independent

*Selected Topics*

*2023 – Present*

- **Odd Perfect Numbers:** Conducted an in-depth exploration into the properties of odd perfect numbers, analyzing their prime divisors and structure. Built foundational knowledge in number theory while exploring longstanding open questions.
- **RSA Cryptography:** Completed a comprehensive study on the RSA encryption algorithm, delving into the underlying number theory and its significance in securing modern communication. Presented findings in an engaging format for peers.
- **Rubik's Cube Groups:** Analyzed the combinatorial complexity of the Rubik's Cube by calculating its total possible configurations using tools in group theory and abstract algebra.
- **Quaternions and Maxwell's Equations:** Studied the applications of quaternions to Maxwell's equations in electromagnetism, offering a novel perspective on theoretical physics through mathematics.

### Functional Gradient Descent Research Project

Collaborate

*Ongoing*

- Developing a novel gradient descent methodology by minimizing a loss functional over a Reproducing Kernel Hilbert Space (RKHS).
- Applying variational calculus to derive optimal functions for minimizing the loss, exploring intersections between advanced calculus and machine learning.

### Asymptotic counting Research project

Collaborate

*Ongoing*

- **Ternary Expansions of  $2^a$  and Selfridge's Conjecture:** Developed an algorithm to identify “digit outliers” (unusually zero-heavy base-3 expansions) among powers of 2, aiming to test hypotheses related to Selfridge's Conjecture. Demonstrated near-uniform digit distribution for large exponents, providing further empirical support but no identified counterexamples.

## TECHNICAL PROJECTS

### Mathematics and Programming Portfolio Development

Independent

*2022 – Present*

- Created and maintained a personal notes-sharing platform for mathematics concepts and research findings.
- Developed algorithms and programs to enhance engagement and understanding of mathematical theories.

### Website Development for Educational Resources

Independent

*2022 – 2024*

- Designed a user-friendly website to provide accessible educational materials on physics and mathematics.
- Focused on usability and accessibility to encourage self-directed learning.

## SKILLS

**Programming:** Python, C, HTML/CSS, Git, LaTeX, Neovim

**Mathematical Tools:** MATLAB, Mathematica

**Research:** Algebra, Data analysis, quantitative modeling, algorithm development, Functional analysis

**Soft Skills:** Communication, leadership, teamwork, time management

**Languages:** English (Fluent), Chinese (Native)