Research Statement

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Introduction

Using mathematics to tackle with real world problem is always what I want to do. My primary research interests lie in **Optimal Control, Machine Learning, and Dynamical Systems**. In particular, I am interested in leveraging optimization techniques and computational methods to address complex mathematical and real-world problems. Through the Polymath Summer Research Program, I hope to engage in to have more practice in problem-solving and team collaboration.

Previous Research Experience

During my undergraduate studies at Jilin University, I actively participated in research projects involving **optimization, differential equations, and machine learning**. One of my most significant projects was *Differential Informed Auto-Encoder*[1], where I explored methods to extract underlying differential structures from datasets. By applying techniques from **numerical analysis and differential equations**, I developed an algorithm that automatically identifies governing differential equations from data.

Additionally, I have employed computational methods to analyze mathematical problems, developing algorithms in **C/C++ and Python** to numerically approximate and validate theoretical results.

Current Research Interests

My current research focuses on the intersection of **optimization, differential equations, and dynamical systems**. Specifically, I aim to use the methods and concept of optimazaiton to tackle with the Differential equations and dynamical systems problems.

Through the Polymath program, I hope to contribute to collaborative mathematical research while refining my ability to tackle real-world problems. I am particularly excited about engaging with researchers who share my passion for solving real world practical problems.

Future Goals

Looking ahead, I aim to further integrate **mathematical optimization with real-world applications**, particularly in areas such as **optimal control and differential equation-**

based modeling. My goal is to develop computationally efficient methods that bridge the gap between theoretical mathematics and practical problem-solving.

Conclusion

The Polymath Summer Research Program presents a unique opportunity to collaborate with leading researchers and peers in tackling significant mathematical challenges. With my strong analytical background, research experience, and enthusiasm for mathematical exploration, I am confident that I can contribute meaningfully to the program while gaining invaluable academic experience.

References

[1] Jinrui Zhang. Differential informed auto-encoder, 2024.