

# Zexuan LIU

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## EDUCATION

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**Wuhan University** September 2017 - June 2021 (expected)  
**B.S. in Mathematics**, School of Mathematics and Statistics & Hongyi Honor College Hubei, CHN  
GPA: 3.92/4.00; Averaged Grade: 92.5/100; Rank: 1/38

**University of California, Berkeley** January 2020 - May 2020  
**Visiting Undergraduate Student** CA, USA  
GPA: 4.00/4.00

Graduate Courses: Nonlinear Programming: A, Matrix Computations (Prof. James Demmel): A

## PUBLICATION

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- [1] Zexuan Liu, Zhiyuan Sun, and Jerry Zhijian Yang. "A NUMERICAL STUDY OF SUPERCONVERGENCE OF THE DISCONTINUOUS GALERKIN METHOD BY PATCH RECONSTRUCTION". In: *Elec. Res. Arch.* (2020), pp. 1-16.

## RESEARCH EXPERIENCE

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**Non-convex Parametric Optimization via Differential Equations** May 2020 - Present  
**Research assistant to Prof. Paul Grigas**

INDUSTRIAL ENGINEERING & OPERATIONS RESEARCH DEPARTMENT  
UNIVERSITY OF CALIFORNIA, BERKELEY

**Overview:** Used ordinary differential equation to develop different second order algorithms for computing an approximately optimal solution path of a parameterized non-convex problem.

- Derived approximate solution path by Euler discretization method
- Developed the error bound of the algorithm
- Modified the algorithm by solving a sub-problem to minimize the upper bound (MINIUPPER)
- Implement MINIUPPER algorithm and prove it has the optimal convergence rate

**Keywords:** Parametric Optimization, Ordinary Differential Equation (ODE), Interpolation, Non-convex.

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**Superconvergence of Discontinuous Galerkin Method** August 2019 - May 2020  
**Research Assistant to Prof. Jerry Zhijian Yang**

SCHOOL OF MATHEMATICS AND STATISTICS  
WUHAN UNIVERSITY

**Overview:** Developed a new Galerkin method by patch reconstruction requiring much less free order than the traditional methods and explored the superconvergence property.

- Developed symmetry element patch picking rule and defined only one degree of freedom (DOF) per element
- Constructed the global stiffness matrix with fix size regardless of the approximation order which may vary
- Implemented the discontinuous Galerkin method by patch reconstruction (DGPR) in MATLAB and C++
- Extended the DGPR method in MATLAB into the 6<sup>th</sup> polynomials while traditional method only use 1<sup>st</sup> order or 2<sup>nd</sup> order polynomials
- Found three different patterns of superconvergence from 1 to 3 dimensions with our DGPR method in elliptic problem when the mesh is geometric symmetry

**Keywords:** Superconvergence, Discontinuous Galerkin method, Patch Reconstruction, Partial Differential Equation (PDE).

## PROFESSIONAL EXPERIENCE

### TIANYUAN MATHEMATICAL CENTER

August 2019 - March 2020

ALGORITHM SPECIALIST

WUHAN UNIVERSITY & HUAWEI

**Overview:** Built a high efficient C++ Machine Learning library for an ARMv8-a architecture server and implemented a *scikit-learn* like C++ machine learning toolkit.

- Developed linear regression models (Ridge regression, Lasso regression and Elastic Net methods) based on OpenBLAS, which are 140% times faster than *scikit-learn* functions on the ARMv8 sever
- Implemented the Word2Vec function whose training is 171% times faster than *scikit-learn* functions on the ARMv8 sever
- Modified the algorithms to parallel system and distributed system (the performance is state-of-the-art)

**Keywords:** High Efficient Computing, Regression, ARMv8, Machine Learning Library, C++

## TEACHING EXPERIENCE

### Teaching Assistant of Numerical Analysis

September 2019 - January 2020

*School of Mathematics and Statistics, Wuhan University*

- Developed an online-judge system with Docker and Django to automatically evaluate codes submitted by students, whose the maximum number of concurrent users exceeds 30
- Taught regression methods, iteration methods and eigen problems with convergence analysis, perturbing theory and implementation
- Delivered the bonus content about the Frank-Wolfe method in Matrix Completion

## TALKS AND SEMINAR

### Hongyi Tournament

November 2019

HONGYI COLLEGE

WUHAN UNIVERSITY

**Topic:** A new efficient discontinuous Galerkin method in Elliptic equations

### Host of Advanced Analysis Seminar

September 2018 - April 2019

SCHOOL OF MATHEMATICS AND STATISTICS

WUHAN UNIVERSITY

- Held this seminar around students of Honor Science Program
- Prepared and delivered an abundant content including topics from Real Analysis to Fourier Analysis which refers to the chapters in Princeton Lectures in Analysis written by Elias M. Stein and Rami Shakarchi

## HONORS AND ACTIVITIES

### Honors:

Scholarship in Honor Program (0.5%), *Hongyi Honor college*

October 2018 & 2019

Merit-Based First Class Scholarship (2.5%), *Hongyi Honor College*

October 2018 & 2019

Second Prize in The Chinese Mathematics Competitions (1.5%), *Chinese Mathematical Society*

November 2018

Outstanding Freshman Scholarship (5%), *Hongyi Honor College*

September 2017

### Activities:

Vice President of the Student Union, *Hongyi Honor College*

September 2018 - June 2019

Volunteer of the Barred Goose Guardian Operation, *Green River program*

June 2018 - Present

## SKILLS AND LANGUAGES

**Programming:** C++, Julia, Python and  $\text{\LaTeX}$

**Softwares and Packages:** Matlab, Docker, Singularity, CMake, TVM

**Operating Systems:** Linux/Unix/macOS

**Language:** Mandarin (native), English (professional)