

Avleen Kaur

PH.D. MATHEMATICS STUDENT

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Summary

My research interests are linear algebra, machine learning, numerical analysis, and partial differential equations (PDEs). The core of my Ph.D. thesis is devising and analyzing space-time spectral methods for PDEs, mainly the Stokes problem. While working on estimating condition numbers for matrices, the idea of deriving a non-trivial lower bound for the minimum eigenvalue of an SPD matrix expressed as a sum of two PSD matrices captured my interest. These results further led to new lower bounds for the minimum singular value of some full-rank block matrices. I also worked with a team on developing an AI tool for detecting defects on road pavements by processing aerial RGB images. A current project includes developing a fast solver for linear systems arising from space-time spectral methods.

In addition to learning mathematics, my other passion is teaching mathematics at various levels. I have taught a second-year engineering mathematical analysis course in Winter 2021, and I have been a teaching assistant for several courses for the past six years at the University of Manitoba. During this time, I also conducted several workshops for preparing students for university-level mathematics and nursing examination. I tutor students registered with special education programs. I love volunteering for mathematics events for elementary school students in Manitoba. I occasionally give free Indian classical music lessons at Gurdwara Nanaksar, Winnipeg.

Education

Ph.D. Mathematics (In Progress)

UNIVERSITY OF MANITOBA

Sept. 2017-PRESENT

- Graduating August 2022
- Supervisor: Dr. Shaun Lui
- Current GPA: 4.33/4.5

M.Sc. Mathematics

UNIVERSITY OF MANITOBA

Sept. 2015-Aug. 2017

- Supervisors: Dr. Craig Cowan, Dr. Shaun Lui
- Thesis Title: The Eigenvalue Problem of the Uzawa Pressure Operator [\[PDF\]](#)
- GPA: 4.40/4.5

M.Sc. Mathematics and Scientific Computing

MOTILAL NEHRU NATIONAL INSTITUTE OF TECHNOLOGY ALLAHABAD

July 2013-May 2015

- **GOLD MEDALIST**
- Supervisor: Dr. Gorakh Nath
- Thesis Title: Series Solution of Shock Wave Problems
- GPA: 9.76/10

B.Sc. Computer Science

GURU NANAK DEV UNIVERSITY, AMRITSAR PB, INDIA

June 2010-June 2013

- University Merit Student

Publications

IN PREPARATION

1. **Space-time ultraspherical spectral methods for linear PDEs.** *Avleen Kaur, S.H.Lui.*
2. **A space-time spectral method for the Stokes problem.** *Avleen Kaur, S.H.Lui.*

IN SUBMISSION

1. **New lower bounds on the minimum singular value of a matrix.**
Avleen Kaur, S.H.Lui.

PUBLISHED

1. **On the blast wave propagation and structure in a rotational axisymmetric perfect gas.**
Avleen Kaur, Gorakh Nath, Satish Chaurasiya.
Proceedings of the National Academy of Sciences, India Section A: Physical Sciences. (2021)

Honors & Awards

2021	PIMS Intern Stipend	<i>PIMS, Canada</i>
2021	Student/Post Doctoral Presentation Prize	<i>CWiMAC, Canada</i>
2020	Fellowship for Education Purposes by Faculty of Science	<i>University of Manitoba</i>
2018	Graduate Award for Excellence in Mathematics	<i>University of Manitoba</i>
2018-2021	University of Manitoba Graduate Fellowship	<i>University of Manitoba</i>
2017	Dr. Murray Gordon Bell Graduate Student Award	<i>University of Manitoba</i>
2016	Second Prize for Graduate Seminar	<i>University of Manitoba</i>
2015	Gold Medal in Master of Science	<i>MNNIT Allahabad</i>
2014	Summer Visiting Student Stipend	<i>IISER Thiruvananthapuram</i>
2013	Merit Student in Bachelor of Science	<i>GNDU Amritsar</i>
2013	Second Prize for Paper Presentation	<i>ACFA Jalandhar</i>
2012	UGC Basic Scientific Research Award	<i>GNDU Amritsar</i>

Conferences and Talks

INVITED TALKS

- Applied and Computational Mathematics Seminar, University of Manitoba
Winnipeg, MB, Canada, February 2022
- International Conference on Spectral and Higher Order Methods (**ICOSAHOM**)
Vienna, Austria, July 2020 2021, Held Online due to COVID-19.

CONTRIBUTED TALKS

- Society for Industrial and Applied Mathematics Annual Meeting (**SIAM-AN21**)
Virtual Conference, July 2021.
- Canadian Applied and Industrial Mathematics Society Annual Meeting (**CAIMS**)
Waterloo, ON, Held Online due to COVID-19, June 2021.
- Connecting Women in Mathematics Across Canada (**CWiMAC**)
STUDENT/POST DOCTORAL PRESENTATION PRIZE
Virtual Conference, June 2021.
- Western Canada Linear Algebra Meeting (**WCLAM**)
Brandon, MB, Held Online due to COVID-19, May 2021.
- SIAM Conference on Applied Linear Algebra (**SIAM-LA21**)
Virtual Conference, May 2021.
- Canadian Mathematical Society (**CMS-STUDC Research**)
Vancouver BC, December 2018.

WORKSHOP PARTICIPATION

- **PIMS Math^Industry Workshop**
Online, August 2021.
 - [Personal Webpage](#), Certificate of participation and description of workshop **[PDF]**
 - Seven courses and two weeks internship with **Aerium Analytics**.
 - Team Project: AI for Road Surface Scanning, see [Project Report](#).
- **AMS Short Course on Mathematical and Computational Methods for Complex Social Systems**
Online, January 2021.
- **CMS Mini Course: Control of Partial Differential Equations**
CMS Winter Meeting, Toronto ON, December 2019.
- **PIMS CRG Summer School: Neural Networks and Deep Learning**
Simon Fraser University, Burnaby BC, July 2019.
- **NPDE-TCA Advanced Level Training Program 2014**
IISER Thiruvananthapuram, Kerala, India, May-June 2014.

- **Summer Visiting Student Programme 2014**
IISER Thiruvananthapuram, Kerala, India, May-July 2014.
- **UGC Basic Scientific Research Scheme 2013**
ACFA Jalandhar PB, India, January-April 2013.

Teaching

EXPERIENCE

Graduate Student Research Mentor

MANITOBA EXPERIMENTAL MATHEMATICS LABORATORY
 • Project: Simulation of fluid flow inside a disk.

Winnipeg, MB
Jan. 2022 - April 2022

Instructor

UNIVERSITY OF MANITOBA
 • MATH 2132-Engineering Mathematical Analysis 2- Winter 2021.
 • Class of 203 students.
 • Letter of performance evaluation [\[PDF\]](#)

Winnipeg, MB
Jan. 2021 - April 2021

Teaching Assistant

UNIVERSITY OF MANITOBA
 • **Nominated for Faculty of Science Award for Excellence in Teaching Assistance.**
 • First year courses include:

- Applied Finite Mathematics
- Calculus I
- Elementary Discrete Mathematics
- Mathematics in Art
- Techniques of Classical and Linear Algebra
- Vector Geometry and Linear Algebra

 • Second year courses include:

- Introduction to Analysis
- Linear Algebra 2
- Mathematical Modelling
- Multi-variable Calculus
- Mathematics for Data Science
- Numerical Analysis I

 • **Math Help Centre**, where students of all first and second year courses come to ask questions.

Winnipeg, MB
Sept. 2015 - PRESENT

Tutor for Pathway to Indigenous Nursing Education

UNIVERSITY OF MANITOBA
 • This is a program designed for aboriginal students studying nursing at the University of Manitoba.

Winnipeg, MB
Sept. 2021 - PRESENT

Instructor for JUMP Math Workshop

PIMS-UNIVERSITY OF MANITOBA
 • A four-day online workshop for preparing students for the Applied Finite Mathematics course at the University of Manitoba.

Winnipeg, MB
Sept. 2020

Instructor for Math Boot Camp

UNIVERSITY OF MANITOBA
 • A series of six online tutorials sessions for teaching Pre-Calculus to the University of Manitoba students.

Winnipeg, MB
Aug. 2020

Instructor for Saturday Workshop Series

UNIVERSITY OF MANITOBA
 • A series of three workshops designed to prepare students for university-level Mathematics.

Winnipeg, MB
Sept. 2019, Jan. 2020, Sept. 2020

Tutor for Aboriginal Nursing Cohort Initiative

UNIVERSITY OF MANITOBA
 • This is a program designed for aboriginal students studying nursing at the University of Manitoba.

Winnipeg, MB
Sept. 2020 - Dec. 2020

Tutor for Access and Aboriginal Focus Programs

UNIVERSITY OF MANITOBA
 • This is a program designed for aboriginal students or for students needing additional support. This job requires to give individual attention to each student and reporting their progress to the instructor.

Winnipeg, MB
Sept. 2019 - Dec. 2020

Teaching Assistant for Math Boot Camp

UNIVERSITY OF MANITOBA
 • A workshop for teaching Pre-Calculus to the University students.

Winnipeg, MB
2016-2017

DEVELOPMENT

Graduate Teaching Program

THE CENTRE FOR THE ADVANCEMENT OF TEACHING AND LEARNING, UNIVERSITY OF MANITOBA

- Accredited through **SEDA**, a professional association in the United Kingdom that promotes innovation and good practices in higher education.
- For more information, see **GTP**.

Winnipeg, MB

May 2021-PRESENT

Graduate Student Teacher Training

UNIVERSITY OF MANITOBA

- Under Dr. Donald Trim.
- A workshop with award-winning educator on teaching techniques which included peer and mentor feedback on a teaching presentation.

Winnipeg, MB

2016

Outreach

PIMS-Math Mania

VOLUNTEER

- A math education outreach programme for children, involving visits to local schools and to schools on remote First Nation reserves.

PIMS Manitoba

2018 - PRESENT

Science Rendezvous

BOOTH CAPTAIN, VOLUNTEER

- A hands-on science festival to encourage public engagement with science.

University of Manitoba

2020, 2019

Service

Committee of Graduate Students for Scientific Interdisciplinary Talks (CoGSIT)

COMMITTEE MEMBER

- The work consists of inviting world-renowned scientists and organizing their talks.

University of Manitoba

Feb. 2019 - PRESENT

Math Kangaroo Contest

VOLUNTEER

- Helped in organizing the event.

University of Manitoba

2019

Mathematics Headship Search Committee

COMMITTEE MEMBER

- A committee for hiring the head of the Department of Mathematics.

University of Manitoba

2018

Department of Mathematics

MASTER'S STUDENTS' REPRESENTATIVE

- Participated in several conferences.
- Organized departmental events.
- Communicated with Master's student for all official activities.

MNNIT Allahabad

2014-2015

Indian Classical Music Training

VOLUNTEER TEACHER

- As a part of free summer school for children at the Gurdwara Nanaksar.

Gurdwara Nanaksar, Winnipeg

2019

Relevant Skills

Languages

C, C++, Julia, HTML, \LaTeX , Machine Learning, MATLAB, PL/SQL, Python, R, SQL.

Software

Anaconda, Atom, Mathematica, Microsoft Softwares, RStudio, Octave.

Noteworthy

High-Performance Computing (HPC) Programmer: an active user of Westgrid and the supercomputer *Grex*.

Extra-Curricular

Classical Indian music singer and instrument player (Harmonium), Gym enthusiast, Runner

References

- **Dr. S.H. Lui**, Professor, Mathematics, University of Manitoba
Shaun.Lui@umanitoba.ca
 - **Dr. Craig Cowan**, Associate Professor, Mathematics, University of Manitoba
Craig.Cowan@umanitoba.ca
 - **Dr. Richard Mikaël Slevinsky**, Assistant Professor, Mathematics, University of Manitoba
Richard.Slevinsky@umanitoba.ca
 - **Dr. Darja Barr**, Instructor, Mathematics, University of Manitoba
Darja.Barr@umanitoba.ca
- Teaching Reference**