Avleen Kaur

Ph.D. Mathematics Student

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Summary

My research interests are linear algebra, numerical analysis, and partial differential equations. The core of my Ph.D. thesis is devising and analyzing space-time spectral methods for partial differential equations, particularly on 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. This problem further leads to new lower bounds for some block matrices. A future 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.

3. **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)

Conferences and Talks

Invited Talks

- 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 (report under revision), see webpage.
- **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.

Honors & Awards

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

Teaching

Instructor *Winnipeg, MB*

UNIVERSITY OF MANITOBA *Jan. 2021 - April 2021*
- MATH 2132-Engineering Mathematical Analysis 2- Winter 2021.
- Class of 203 students.
- Letter of performance evaluation **[PDF]**

Teaching Assistant *Winnipeg, MB*

UNIVERSITY OF MANITOBA *Sept. 2015 - PRESENT*
- 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.

Graduate Student Research Mentor *Winnipeg, MB*

MANITOBA EXPERIMENTAL MATHEMATICS LABORATORY *Jan. 2022 - April 2022*
- Project: Simulation of fluid flow inside a disk.

Tutor for Pathway to Indigenous Nursing Education *Winnipeg, MB*

UNIVERSITY OF MANITOBA *Sept. 2021 - PRESENT*
- This is a program designed for aboriginal students studying nursing at the University of Manitoba.

Instructor for JUMP Math Workshop *Winnipeg, MB*

PIMS-UNIVERSITY OF MANITOBA *Sept. 2020*
- A four-day online workshop for preparing students for the Applied Finite Mathematics course at the University of Manitoba.

Instructor for Math Boot Camp *Winnipeg, MB*

UNIVERSITY OF MANITOBA *Aug. 2020*
- A series of six online tutorials sessions for teaching Pre-Calculus to the University of Manitoba students.

Instructor for Saturday Workshop Series *Winnipeg, MB*

UNIVERSITY OF MANITOBA *Sept. 2019, Jan. 2020, Sept. 2020*
- A series of three workshops designed to prepare students for university-level Mathematics.

Tutor for Aboriginal Nursing Cohort Initiative *Winnipeg, MB*

UNIVERSITY OF MANITOBA *Sept. 2020 - Dec. 2020*
- This is a program designed for aboriginal students studying nursing at the University of Manitoba.

Tutor for Access and Aboriginal Focus Programs *Winnipeg, MB*

UNIVERSITY OF MANITOBA *Sept. 2019 - Dec. 2020*
- 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.

Teaching Assistant for Math Boot Camp *Winnipeg, MB*

UNIVERSITY OF MANITOBA *2016-2017*
- A workshop for teaching Pre-Calculus to the University students.

Graduate Teaching Program *Winnipeg, MB*

THE CENTRE FOR THE ADVANCEMENT OF TEACHING AND LEARNING, UNIVERSITY OF MANITOBA *May 2021-PRESENT*
- Accredited through **SEDA**, a professional association in the United Kingdom that promotes innovation and good practices in higher education.
- For more information, see **GTP**.

Graduate Student Teacher Training *Winnipeg, MB*

UNIVERSITY OF MANITOBA *2016*
- Under Dr. Donald Trim.
- A workshop with award-winning educator on teaching techniques which included peer and mentor feedback on a teaching presentation.

Outreach

PIMS-Math Mania *PIMS Manitoba*

VOLUNTEER *2018 - PRESENT*

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

Science Rendezvous *University of Manitoba*

BOOTH CAPTAIN, VOLUNTEER *2020, 2019*

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

Service

Committee of Graduate Students for Scientific Interdisciplinary Talks (CoGSIT) *University of Manitoba*

COMMITTEE MEMBER *Feb. 2019 - PRESENT*

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

Math Kangaroo Contest *University of Manitoba*

VOLUNTEER *2019*

- Helped in organizing the event.

Mathematics Headship Search Committee *University of Manitoba*

COMMITTEE MEMBER *2018*

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

Department of Mathematics *MNNIT Allahabad*

MASTER'S STUDENTS' REPRESENTATIVE *2014-2015*

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

Indian Classical Music Training *Gurdwara Nanaksar, Winnipeg*

VOLUNTEER TEACHER *2019*

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

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. Darja Barr**
  Instructor, Mathematics
  University of Manitoba
  Darja.Barr@umanitoba.ca
  Teaching Reference