Rachneet Kaur

Education

- **University of Illinois at Urbana Champaign, US** — 4.0/4.0 — Aug 2018 – 2022
  PhD Industrial Engineering (Operations Research and Data Analytics)
  Advisor: Prof. Richard Sowers
- **Indian Institute of Technology (IIT), Delhi, India** — 9.22/10 — July 2013 – May 2015
  Master of Science in Mathematics (Department Rank: 2)
  Advisor: Prof. Aparna Mehra
- **Ramjas College, University of Delhi, India** — 87.6% — July 2010 – May 2013
  Bachelor of Science (Hons) Mathematics (College Rank: 2)

Honors and Awards

- ACM Invitation and Travel Grant for Grace Hopper Celebration for Women — Sept 2020
- Willian A. Chittenden Graduate Fellowship 2019 Award ($ 15,000) — Aug 2019-2020
  (Awarded to ~2 graduate students in Industrial and Systems Engineering) — May 2019
- UIUC Graduate College ISE Fellowship ($ 1800) — March 2019
- UIUC Graduate College Spring Conference Travel Award — Nov 2018
- Travel Award, Women in Machine Learning (WiML) Workshop, NIPS — Nov 2018
- UIUC Conference Travel Award, INFORMS Annual Meeting — Aug 2018-2019
- Willian A. Chittenden Graduate Fellowship 2018 Award — Sept 2018
- ACM Invitation and Travel Grant for Grace Hopper Celebration for Women — Apr 2018
- 1st runner up, UIUC ISE Travel Poster Competition Award — Mar 2018
- Illinois Geometry Lab Research Award — Dec 2017
- (Awarded to ~1 research team across Department of Mathematics) — Nov 2017
- 1st runner up, Mottier Innovation Challenge in Systems Engineering Award — Oct 2017
- (Awarded to top research teams across Industrial and Systems Engineering) — June 2016
- UIUC Conference Travel Award, INFORMS Annual Meeting — Mar 2015
- UIUC Conference Travel Award, BMES Annual Meeting — 2013
- Top 10, World Quant Summer Challenge (INR 50,000) — 2013
- Winner, Charpak Research Intern Scholarship 2015 — Dec 2012
- (Awarded to ~30 students across India) — 2010
- All India Rank 40, IIT- JAM (Joint Admission Test) Mathematics — 2009
- All India Rank 39, IIT- JAM (Joint Admission Test) Mathematics and Statistics — 2008
- Winner, The Legacy of Srinivasa Ramanujan Coding Competition

  (Awarded at the International conference The Legacy of Srinivasa Ramanujan, 2012)
  Merit certificates in Mathematics and Computer Science by CBSE
  (Awarded to top 0.1% students across India)
  Winner, Central level Science Quiz, Directorate of Education
  (Awarded to 1 team across each state in India)
  Merit certificates in Mathematics and Social Science by CBSE
  (Awarded to top 0.1% students across India)

Publications

- **Rachneet Kaur,** Maxim Korolkov, Manuel E Hernandez, Richard Sowers. Automatic Identification of Brain Independent Components in Electroencephalography Data Collected while Standing in a Virtually Immersive Environment-A Deep Learning-Based Approach. In *42nd Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, July 2020. (oral presentation)
- Yang Hu, Alka Bishnoi, **Rachneet Kaur**, Richard Sowers, Manuel E Hernandez. Exploration of Machine Learning to Identify Community Dwelling Older Adults with Balance Dysfunction Using Short Duration Accelerometer Data. In *42nd Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, July 2020.

- Vipul K Satone, **Rachneet Kaur,** Hampton Leonard, Hirotaka Iwaki, Lana Sargent, Sonja W Scholz, Mike A Nalls, Andrew B Singleton, Faraz Faghri, Roy H Campbell. Predicting Alzheimer's disease progression trajectory and clinical subtypes using machine learning. Under review Aug 2020.

- **Rachneet Kaur,** Rongyi Sun, Liran Ziegelman, Richard Sowers and Manuel Hernandez. Using Virtual Reality to Examine the Neural and Physiological Anxiety-Related Responses to Balance-Demanding Target-Reaching Leaning Tasks. In *IEEE-RAS International Conference on Humanoid Robots (Humanoids),* Oct 2019.

- Rongyi Sun, **Rachneet Kaur**, Liran Ziegelman, Shuo Yang, Richard Sowers, Manuel E Hernandez. Using Virtual Reality to Examine the Correlation between Balance Function and Anxiety in Stance. *In 2019 IEEE International Conference on Bioinformatics and Biomedicine (BIBM),* Nov 2019.

- **Rachneet Kaur**, Sanjana Menon, Xiaomiao Zhang, Richard Sowers and Manuel Hernandez. Exploring characteristic features in gait patterns for predicting Multiple Sclerosis. In *41th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, July 2019. (oral presentation)

- **Rachneet Kaur**, Rongyi Sun, Liran Ziegelman, Richard Sowers and Manuel Hernandez. Using Virtual Reality to Examine the Neural and Physiological Responses to Height and Perturbations in Quiet Standing. In *41th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, July 2019.

- **Rachneet Kaur**, Manuel Hernandez and Richard Sowers. Virtual Reality and Movement Disorders. Invited chapter in book *Virtual Reality: Recent Advancements, Applications and Challenges, River Publishers, 2019*. Vipul Satone, **Rachneet**
- **Kaur**, Faraz Faghri, Mike A Nalls, Andrew B Singleton and Roy Campbell. Learning the progression and clinical subtypes of Alzheimer's disease from longitudinal clinical data. In *NeurIPS 2018, Machine Learning for Health (ML4H) Workshop,* Dec 2018.

- **Rachneet Kaur**, Xun Lin, Alexander Layton, Manuel Hernandez and Richard Sowers. Virtual Reality, Visual Cliffs, and Movement Disorders. In *40th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, July 2018. (oral presentation)

Patents

- Gautam Singh, John M. Cruse, **Rachneet Kaur** et. al. Methods and systems for path-based mapping and routing, 3M Innovative Properties Company, 3M Company. Provisional application filed on 4 June 2019.

Research Poster Presentations

- Using Virtual Reality High Fall-Risk Condition Training to Improve Postural Control Accuracy and Speed
  Rachneet Kaur, Rongyi Sun, Richard Sowers and Manuel Hernandez
  Accepted at the *American Congress of Rehabilitation Medicine (ACRM) 96th Annual conference,* Progress in Rehabilitation Research, Nov 2019

- Using Virtual Reality to examine the correlation between balance function and anxiety in a quiet stance
  Rongyi Sun, Liran Ziegelman, Shuo Yang, **Rachneet Kaur**, Richard Sowers and Manuel E. Hernandez
  Accepted at the *Biomedical Engineering Society (BMES) Annual Meeting*, Oct 2019

- Predicting Multiple Sclerosis Disorder from Gait Patterns
  Rachneet Kaur, Xiaomiao Zhang, Yikun Zhou, Pavitra Shadvani, Manuel Hernandez and Richard Sowers
  Presented at the *9th International IEEE EMBS Conference on Neural Engineering (NER)*, March 2019 and at the *Illinois Geometry Lab Poster session* by the UIUC Mathematics Department, Spring 2019.

- Learning the progression and clinical subtypes of Alzheimer's disease from longitudinal clinical data
  Vipul Satone, **Rachneet Kaur**, Faraz Faghri, Mike A Nalls, Andrew B Singleton and Roy Campbell
  Accepted at the *NeurIPS 2018, Women in Machine Learning (WiML) Workshop,* Dec 2018
  Accepted at the *NeurIPS 2018, Machine Learning for Health (ML4H) Workshop,* Dec 2018

- Visual Cliffs, Virtual Reality and Movement Disorders
  Rachneet Kaur, Yizhen Ding, Alex Rios, Manuel Hernandez and Richard Sowers
  Presented at the ACM poster presentation session at the *Grace Hopper Celebration for Women*, Sept 2018

• Predicting the progressions of Alzheimer's disease using Machine Learning
Vipul Satone, **Rachneet Kaur**, Faraz Faghri and Roy Campbell
Presented at the *2nd Illinois Health Data Analytics Summit*, Apr 2018

• Optimal IoT Control for Smart Homes
Rachneet Kaur, Karthik Venkata, Clara Schaye, Daniel Yee, Rachel Zilz, Kevin Thompson and Richard Sowers
Presented at the *Coordinated Science Laboratory Student Conference, University of Illinois at Urbana Champaign*, Feb 2018

• IoT for Power Consumption
Rachneet Kaur, Clara Schaye, Daniel Yee, Rachel Zilz, Kevin Thompson, R.S. Sreenivas and Richard Sowers
Presented at the *IEEE Power and Energy Conference (PECI) at Illinois,* Feb 2018

• Visual Cliffs, Virtual Reality and Movement Disorders
Rachneet Kaur, Daan Michiels, Manuel Hernandez and Richard Sowers
Presented at the *Institute for Operations Research and the Management Sciences (INFORMS) Annual Meeting*, Oct 2017 and at the *Illinois Geometry Lab Poster session* by the UIUC Mathematics Department, Spring 2017, Fall 2017, Spring 2018, Fall 2018 and Spring 2019.

• A Brain computer interface approach to examine changes in anxiety while walking in a virtually infinite world
Rachneet Kaur, Daan Michiels, Manuel Hernandez and Richard Sowers
Presented at the *Biomedical Engineering Society (BMES) Annual Meeting*, Oct 2017

• IoT Dishwasher
Rachneet Kaur, Clara Schaye and Daniel Yee
Presented and demoed at the *Mottier Innovation Challenge in Systems Engineering*, Nov 2017, for *John Deere,* Apr 2018, by UIUC undergraduate students at the *UIUC Engineering Open House,* March 2019 and at the UIUC Undergrad Research Symposium, Apr 2019.

• Computing with words
Rachneet Kaur and Aparna Mehra
Presented through a poster presentation at *Engineering Open House, Indian Institute of Technology - Delhi*, Apr 2015

Research Talks

• Virtual Reality, Visual Cliffs and Movement Disorders
Rachneet Kaur, Xiaomiao Zhang, Yikun Zhou, Pavitra Shadvani, Manuel Hernandez and Richard Sowers
Presented at the Machine Learning in Hardware session, *Coordinated Science Laboratory Student Conference, University of Illinois at Urbana Champaign*, Feb 2019

• IoT for Power Consumption
Rachneet Kaur, Kevin Thompson, R.S. Sreenivas and Richard Sowers
Presented (oral) at the *Institute for Operations Research and the Management Sciences (INFORMS) Annual Meeting*, Nov 2018

• Invited webinars on algorithmic trading, World Quant
Rachneet Kaur
Served as a panelist for two invited webinars for the *World Quant Summer Training Program* and *Summer Alphathon*, 2016

• Retrieving the playfair matrix from a given string of plain text and the corresponding cipher text
Rachneet Kaur, Kanika Wadhwa, Ritika Gulati, Neha Gupta and Neha Raturi
Presented the solution algorithm and C++ code developed as part of *The Legacy of Srinivasa Ramanujan Competition* at the seminars on cryptography at the *Universities of Cambridge and Oxford*, U.K, June 2013

Current Research projects

• **Deep Learning to Limit Order Books** **Jan 2018 – Present**
(Advisor: Prof. Justin Sirignano*, Industrial Engineering Department, UIUC*)
- Exploring and implementing multi scale LSTM, Resnet architectures to analyze the spatial nature of the high frequency limit orders for price prediction on ~500 US stocks
- Comparing neural architectures with state-of-the-art pricing prediction models and machine learning approaches
- Implementing novel architectures for prediction of volume of stocks traded in a high frequency setup
- Devising data augmentation strategies based on financial markets to improve the performance of the networks

• **Predicting progressions and subtype of Alzheimer's disease** **Jan 2018 – Present**

(Advisor: Prof. Roy Campbell*, Computer Science Department, UIUC*)

- Incorporating supervised and unsupervised algorithms to predict the clinical progressions and subtypes of Alzheimer's disease using clinical records
- Exploring the relations of progression rate between Parkinson's and Alzheimer's onset by machine learning algorithms

• **Internet of Things for optimal power consumption** **Oct 2016 - Present**

(Advisor: Prof. Richard Sowers*, Industrial Engineering and Mathematics Department, UIUC*)

- Working on Python to develop predictive models and compute optimal stopping time for electricity prices.
- Working to build an IoT device to switch on appliances optimally to benefit both consumers and producers of ComEd.

• **Visual Cliffs, Virtual Reality and Movement Disorders** **Jan 2017 – Present**

(Advisor: Prof. Richard Sowers*, Industrial Engineering and Mathematics Department, UIUC*)

- Using a Virtual Reality headset (HTC Vive) to let people walk through a virtual world that is apparently dangerous.
- At the same time, using a brain-computer interface in the form of an EEG to record brain waves and estimate the person's anxiety level.
- The tools we develop form the basis of a platform to study how anxiety influences people's motion patterns.

Work Experience

Data Science Intern, *VISA Research Team, VISA* **Summer 2019**

(Mentors: Carolina Barcenas, Chiranjeet Chetia)

- Formulated and designed an AI based Early Warning System to detect extremely rare fraudulent credit card testing activities to mitigate Cashouts (costing millions in loss within minutes) in advance.
- Deep-dived into available business case studies, fetched and statistically analyzed TB sized transactional data using Hadoop and Python to model characteristic features for the problem.
- Implemented supervised and unsupervised deep learning models for generating real time alerts for testing activities using Tensorflow.

R&D Data Science Intern, *Electronics, Software & AI Research Team, 3M, Minneapolis* **Summer 2018**

(Mentors: David Redinger, Brian Stankiewicz)

- Worked to develop an intelligent framework in OpenCV providing real time situation awareness and optimal navigation.
- Completed sensor fusion in Python using sophisticated noise filtration, bias removal, gap filling and time syncing techniques.
- Implemented and deployed a deep learning framework on AWS for real time object detection in optimal route navigation.

Exploratory Quantitative Research Intern*, Quantlab Financial LLC, Boston* **Summer 2017**

(Mentors: Areez Mody, Matteo Nicoli)

- Designed and implemented algorithmic high frequency trading strategies and metrics evaluating their quality for equities.
- Analyzed TB sized prices data using C++ and Python and designed statistical methods to improve prediction accuracy.
- Rationally combined alphas implementing machine learning methods on historical data, consistently improving the quality.

Quantitative Research Summer Training Program, *World Quant LLC, India* **Summer 2016**

- Awarded a part time Quantitative Research Consultancy position after achieving Gold level (Top 10) on Websim
- Conceptualized and designed mathematical risk management models to approximate future price movements
- Devised 300+ novel high return algorithmic trading strategies using predictive models for stocks

Graduate Research Intern, *Universite Paris I, France* **Summer 2015**
(Mentor: Julien Randon Furling)

- Granted the Charpak Scholarship, 2015 from the French Embassy, conferred to 31 students all over India
- Implemented dynamic variants of the Schelling's spatial proximity graph separation mathematical model in MATLAB

Research Intern, *Tata Institute of Fundamental Research, India* **Summer 2014**
(Mentor: Mythily Ramaswamy)

- Developed efficient codes in MATLAB for finite element and finite difference schemes for elliptic and heat equations.
- Theoretically and computationally investigated error bounds of the numerical schemes for solving differential equations.

Research Intern, *National Program on Differential Equations, National Institute of Technology, Calicut* **Winter 2013**
(Mentors: Satyananda Panda, T. Suman Kumar)

- Studied differential population models and fitted them in MATLAB to forecast the population of Indian cities.
- Studied schemes of age structured nonlinear population models and implemented them in MATLAB

Academic Service and Leadership Activities

• **Program Committee:** Fair ML for Health (FMLHNIPS2019), NeurIPS 2019

• **Reviewer:** Machine Learning for Health (ML4H) workshop, NeurIPS 2019

Medical Imaging meets NeurIPS (MED-NeurIPS) workshop, NeurIPS 2019
Fair ML for Health (FMLHNIPS2019), NeurIPS 2019
Women in Machine Learning (WiML) Workshop, NeurIPS 2018

• **Graduate Mentor:** Illinois Geometry Lab Spring 2017, Fall 2017, Spring 2018, Fall 2018, Spring 2019
Duties:
• Mentored ~10 undergraduate students each session from Department of Mathematics and computer science taking Research credit projects in MATH 492 and independent study credits with Prof. Richard Sowers

• **Graduate Teaching Assistant, University of Illinois at Urbana Champaign**
Courses:
• • •CS 547/IE 534 Deep Learning (Fall 2019)
IE 361 Production Planning and Control (Spring 2019)
IE 300 Analysis of Data (Fall 2016, Spring 2017, Fall 2017, Spring 2018, Fall 2018)
Duties:
- Held discussion sessions and office hours administering data analysis techniques in R and Python
• Worked in a team to develop course content and assignments for the courses

• **Member:** Women in Computer Science Fall 2016

• **Open House Coordinator:** Indian Institute of Technology Delhi Mar - Apr 2016
Duties:
• • Spearheaded a team of 50+ volunteers managing 500+ schools participating in the event
Organized the Open House press conference and regulated press coverages prior and during the event
Strategized and guided execution of the inaugural ceremony and talks for the biggest intraday events of IITD

• **Event Management Volunteer**, Rubic's Cube Indian Nationals, IIT Delhi Feb - Mar 2016
Duties:
- Acted as a judge for various tournaments and managed attendees throughout the sessions

• **Publicity Volunteer**, Spic Macay, IIT Delhi
Duties: Jan - Mar 2016
- Coordinated for offline and online journalistic activities during the 10 day long cultural fest

• **Event Management Volunteer**, *Tryst, IIT Delhi*
Duties: Jan - Mar 2015
• Managed the mathematics department events for one of the biggest technical fests of India

- Conducted statistical analysis on milk surveys for Delhi University's innovation project — Dec 2015
- Designed an android app 'Grow Safe' for the NASA International Space Apps Challenge — Apr 2015
- Collaborated in a team of 2 to create a Windows game 'ColorOManiac' for Microsoft Code. Fun. Do — Jan 2014
- Coordinated in a team of 3 to design an android application 'HelpMeA(sa)pp' for Yahoo Hack U — Aug 2013

Press Coverage

Brain Computer Interface to examine changes in a virtual world

Internet of Things for optimal power consumption

Crypto graphy solution to retrieve the playfair matrix from a given plain and the corresponding cipher text

Relevant Coursework

UIUC:

Deep Learning (CS 598) [A+]
Advanced Information Retrieval (CS 510) [A+]
Introduction to Data Mining (CS 412) [A+]
Stochastic Processes and applications (CS481)
Algorithms for Data Analytics (IE 531) [A+]
Stats of Big Data (IE 529) [A+]
Health Data Analytics (CS 598) [A+]
Decision Analysis (GE450) [A+]
Statistical Learning (STAT 542)
Optimization of large-scale systems (IE411) [A+]

Linear Algebra and its financial applications (MATH410) Integer Programming (IE 511) [A+]
Computing for ISE (IE 498) [A+]

IIT Delhi:

Advanced Computational Methods (AML702)
Applied Analysis (MTL882)
Applied Numerical linear algebra (EEL722)
Applied non-linear programming (MAL638)
C++ programming and numerical methods (B303)
Integer Programming (IE 511)
Linear Algebra (MAL860)
Numerical and computational methods in research
Numerical optimization (MAL704)
Complex analysis (MAL514)
Computer oriented operations research (MAL526)
Differential equations (MAL517)
Fuzzy sets and applications (MAL717)
MATLAB computing (MAP702)
Numerical analysis (MAL524)
Methods of applied mathematics (MAL518)
Probability theory (MAL509)
Statistical inference (MAL522)

Technical Skills

Programming: C++, Python, MATLAB, SQL, Basics of R and JAVA
Software: MS Office, Latex, Eclipse and Visual Studio

Past projects

Learning to Rank for text document prioritization — **Aug - Dec 2017**

(Advisor: Prof. Cheng Xiang Zhai, *CS510 Advanced Information Retrieval Project*)

- Implemented Stochastic Pairwise Descent ranking function with SVM to extend the Python MeTA text retrieval toolkit.
- Compared the mean average precision and training speed of our implementation of SPD with LTR ranking method.

Movie Review Sentiment Analysis — **Jan - Apr 2017**

(Advisor: Prof. Feng Liang, *STAT542 Statistical Learning Project)*

- Implemented logistic regression, Random forest and XGBoost for BOW, TF-IDF and LDA to predict IMDB sentiments.
- Visualized sentiment word tagging, word cloud and word frequency plots revealing the essence of the prediction model.

Distributed K means **Aug - Dec 2017**

(Advisor: Prof. Carolyn L Beck, *IE529 Stats of Big Data Project*)

- Implemented Distributed k-Means Clustering on General Topologies.
- Since the whole dataset cannot be transferred from each node to the centralized node, a coreset is transferred to save a considerable amount of communication cost. The communication cost for the coreset algorithm was considerably less.

Deep Patient **Jan - May 2018**

(Advisor: Prof. Roy Campbell, *CS 598 Health Data Analytics Paper Presentation*)

- Presentation on Deep Patient: An Unsupervised Representation to Predict the Future of Patients from the Electronic Health Records by Riccardo Miotto et al