Aaron Berk

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Aaron Berk, Dept. Mathematics
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Education

University of British Columbia — Vancouver, BC
Ph.D. Applied Mathematics — *Sep 2015 – Aug 2021*

- On Lasso parameter sensitivity
- Principal Supervisors: Dr. Özgür Yilmaz and Dr. Yaniv Plan
- Also supervised by Dr. Ipek Oruc
- Awarded Four-Year Fellowship (institutional)
- Awarded NSERC CGS-D (national)
- Member of IAM Student Committee and Mathematics Grad Student Committee

University of Toronto — Toronto, ON
M.Sc. Mathematics — *Sep 2013 – Aug 2014*

- On multiscale analysis and PDE methods on graphs in image processing
- Supervisor: Dr. Adrian Nachman
- 90% cumulative average
- Math rep to UT Graduate Students Union

McMaster University — Hamilton, ON
B.Sc. Hon. Maths & Stats — *Sep 2009 – Aug 2013*

- Dean's Honours List (2009 - 2013)
- The McMaster Honour Award, Level 3 (2009)
- The University (Senate) Scholarship (2010, 2012)
- NSERC USRA (2012, 2013)
- 11.5 cumulative average (3.95 GPA)

Selected Research Experience

Postdoctoral Fellow — Concordia University — Sept 2021 –
Drs. Simone Brugiapaglia (Concordia) & Tim Hoheisel (McGill) — Montréal, QC

- Realistic sampling strategies for deep generative inverse problems in medical imaging

Intern — Learning for Inverse Problems & Dynamical Systems — May – Sept 2021
Mitsubishi Electric Research Laboratories — Boston, MA, USA

Graduate Researcher — Compressed Sensing & Machine Learning — Sept 2015 – Present
Drs. Özgür Yilmaz, Yaniv Plan & Ipek Oruc, UBC — Vancouver, BC

- Researching convex methods for compression and recovery of structured high-dimensional data using geometric functional analysis and high-dimensional probability.
- Researching deep learning methods for medical imaging with applications to ophthalmology and the automated investigation of patient health.
- Experienced user of PyTorch for training deep neural networks.

Data Scientist — Feature Selection & Signal Processing — Oct 2016 – Feb 2017
Andrea Palmer, Paul Fijal — Awake Labs, Vancouver, BC

- Mitacs Accelerate internship: affective computing R&D for quality of life improvement in children on the autism spectrum.
- Researched optimization & feature selection methods for structured time series analysis.

Graduate Researcher — Medical Imaging Algorithms — May – Aug 2014
Supervisor: Dr. Adrian Nachman, University of Toronto — Toronto, ON

- Researched variational methods in image processing to develop fast computational methods with applications to medical imaging.
- Relied heavily on wavelet methods, numerical methods for PDE (gradient descent, spectral methods, convex splitting), eigenvalue problems (the Nyström Extension), matrix conditioning.

Undergraduate Research Assistant — Computational Fluid Dynamics May – Aug 2013
Supervisor: Dr. Nicholas Kevlahan, McMaster University Hamilton, ON

- Researched adaptive wavelet methods for solving PDEs on irregular and spherical domains; examined efficacy of these methods in solving shallow water equations subject to realistic bottom bathymetry and coastline data.
- Wrote a software library in MATLAB to process and visualize geophysical images and data, using level set methods to morphologically alter real data according to its geometric properties.

Undergraduate Research Assistant — Computational Stats, Math Ecology May – Aug 2012
Supervisor: Dr. Benjamin Bolker, McMaster University Hamilton, ON

- Optimized and analyzed GLM models for heteroskedastic pine seed and pine seedling spatial population distributions (using `nlme`, `stats`, and `RandomFields` in `R`).
- Created protocols in `R` to retrieve, analyze and visualize large-scale bibliometric data.

Summer Research Assistant — Computational Mathematical Biology May – Aug 2011
Supervisor: Dr. Diamandis, SLRI, Mt. Sinai Hospital Toronto, ON

- Developed and simulated a mathematical model to simulate the effect of chemotactic enzyme gradients on tumour morphology and tumour cell movement (using `R`) (Karagiannis, *et al.*, 2013)
- Assisted lab members with data processing and statistical analysis using Microsoft Excel and `R`

Articles Published & In-progress

[1] **AB**, Y. Plan, and O. Yilmaz, "A well-ordering property for proximal operators," *(in preparation)*, 2020.

[2] **AB**, G. Ozturan, D. Maberley, O. Yilmaz, and I. Oruc, "A deep learning approach to understanding retinal fundus imaging," *(in preparation for PLOS One)*, 2020.

[3] **AB**, Y. Plan, and Ö. Yilmaz, "On the best choice of LASSO program given data parameters," *submitted to IEEE Transactions on Information Theory, revisions requested, 49 pages*, 2020. arXiv preprint arxiv:2010.08884.

[4] **AB**, "Deep generative demixing: Error bounds for demixing subgaussian mixtures of Lipschitz signals," in *IEEE ICASSP 2021*, pp. 4010–4014, 2021. doi:10.1109/ICASSP39728.2021.9413573.

[5] **AB**, "Deep generative demixing: Recovering Lipschitz signals from noisy subgaussian mixtures." arXiv:2010.06652, October 2020.

[6] **AB**, Y. Plan, and Ö. Yilmaz, "Sensitivity of ℓ_1 minimization to parameter choice," *Information and Inference: A Journal of the IMA*, 2020. doi:10.1093/imaiai/iaaa014.

[7] **AB**, Y. Plan, and O. Yilmaz, "Parameter instability regimes in sparse proximal denoising programs," in *SampTA*, 2019. doi:10.1109/SampTA45681.2019.9030982.

[8] **AB** and E. White, "Up in the air: The mathematics of juggling," *Crux Mathematicorum*, vol. 45, no. 8, pp. 471–475, 2019. (link to pdf).

[9] G. S. Karagiannis, **AB**, A. Dimitromanolakis, and E. P. Diamandis, "Enrichment map profiling of the cancer invasion front suggests regulation of colorectal cancer progression by the bone morphogenetic protein antagonist, gremlin-1," *Molecular oncology*, vol. 7, no. 4, pp. 826–839, 2013. doi:10.1016/j.molonc.2013.04.002.

Selected Research Talks

The Mathematics of Sparse Recovery and Machine Learning CAIMS-SIAM AN20
"Parameter sensitivity in ℓ_1 minimization" *Jul 2020*

- Invited research talk on probabilistic tools for analyzing LASSO parameter sensitivity.

Virtual Vision Sciences Society 2020 — Vision Sciences Society
"Learning from few examples: Classifying sex from retinal images" — *Jun 2020*

- Accepted research poster on deep learning performance for ophthalmology applications.
- doi:10.1167/jov.20.11.255

PIMS CRG Summer School — Simon Fraser University
PIMS CRG Summer School: Deep Learning for Computational Mathematics — *Jul 2019*

- Invited research talk on deep learning applications to medical imaging in ophthalmology.

SampTA 2019 — Université Bordeaux
13th International Conference on Sampling Theory and Applications — *Jul 2019*

- Accepted research talk on sensitivity of ℓ_1 minimization to parameter choice.

UBC Department of Ophthalmology & Visual Sciences — VGH/UBC Eye Care Centre
35th Annual O&VS Research Day — *April 2019*

- Research talk on a deep learning approach to understanding retinal fundus images.
- Winner of Graduate Student Presentation Award.

PIMS Mathematical Education Circles — University of British Columbia
"The mathematics of juggling" — *March 2019*

- Talk on the "lighter side of mathematics".
- Introduced high school teachers, teaching faculty and research faculty to the mathematics underlying juggling.
- Facilitated a mini-workshop in which participants learned to juggle in "ten minutes or less".

SFU Computational Math Seminar — Simon Fraser University
"Program selection for sparse proximal denoising" — *March 2019*

- Invited research talk on parameter instability in sparse proximal denoising programs.

Banff International Research Station — Banff International Research Station
Intersection of Information Theory and Signal Processing — *October 2018*

- Invited research talk on parameter instability in proximal denoising programs.

PIMS High Dimensional Data Analysis — University of British Columbia
Mathematical Foundations of Data Science — *August 2018*

- Invited research talk on parameter instability in compressed sensing programs.

International Matheon Conference — Technische Universität Berlin
Compressed Sensing and its Applications — *December 2017*

- Contributed research poster on sensitivity in sparse proximal denoising programs.

Selected Honours & Awards

CRM Applied Math Lab Postdoctoral Fellowship — $50 000 *p.a.*
Centre de recherches mathématiques (Montréal, QC) — *Sept 2021*

British Columbia Graduate Scholarship — $15 000
Province of BC, UBC — *Jan 2021*

MDS TA Award — $100
UBC Master's of Data Science — *Jun 2020*

Margaret L. Adamson Award — $2 000
UBC Ophthalmology and Visual Sciences — *Dec 2019*

Acclerate internship — $15 000
Mitacs, Awake Labs — *Oct 2016*

Canada Graduate Scholarship—Doctoral (CGS-D) — $35 000 *p.a.*
NSERC, UBC — *Sept 2016*

Four Year Fellowship — $18 000 *p.a.*
University of British Columbia — *Spring 2015*

Canada Graduate Scholarship (Master's level) — $17 500 *[declined]*
NSERC, University of Toronto — *Fall 2014*

Blythe Fellowship — $16 500
University of Toronto — *Fall 2013*

Ontario Graduate Scholarship — $15 000 *[declined]*
McMaster University — *Spring 2013*

NSERC Undergraduate Student Research Award — $6 500
McMaster University — *Summer 2012, 2013*

Samuel Lunenfeld Research Award — $6 500
Mt. Sinai Hospital, Toronto, ON — *Summer 2011*

Facilitation & Teaching Experience

Sessional Instructor — Dept Statistics, UBC, Vancouver BC
UBC Masters of Data Science program — *Sep 2020 – October 2020*

- Lecture and lab instructor for the 1-block course DSCI 551: Probability & Descriptive Statistics
- Created weekly lab assignments, bi-weekly quizzes and twice-weekly lectures, with focuses on: dependence, simulation, and conditional probability, contextualized for professional data science.

TA Trainer & Facilitator — Dept Mathematics, UBC, Vancouver BC
UBC Mathematics TA Training — *Sep 2018, 2019, 2020*

- Developed, led content delivery for and facilitated small-group activities for new graduate student TAs in the Department, focusing on Facilitative Teaching, Marking, online coursewares, Expectations, Communication, and Diversity.
- Developed a web-based Canvas module on Expectations & Diversity, as these topics pertain to being a Canada-based teaching assistant, mathematician and academic in the international academe.

Mathematics Host — Science World, Vancouver BC
Future Science Leaders — *Jan 2019 & Jan 2020*

- Outreach program for engaged, highly motivated high school students interested in STEM fields.
- Led content delivery and facilitated small-group activities.
- Developed modules for self-guided learning for cryptography with Python.

Workshop Organizer and TA — PIMS, UBC IAM
BC Data Science Workshop — *Jan – Jun 2017, 2018*

- Served as co-organizer for the 2017 and 2018 BC Data Science Workshop.
- Coordinated with industry mentors to develop projects of suitable scope.
- Mentored student teams through facilitation of research ideas and background knowledge.
- Designed and led 2017 mini-project sessions.

Participant — UBC Dept. Mathematics
Instructional Skills Workshop — *May 2016*

- Three day intensive workshop developing effective teaching and facilitation practices, with a focus on teaching and learning in a mathematics settings.

Teaching Assistant Experience

Master of Data Science program — University of British Columbia
Teaching Assistant — *Sept 2017 – May 2020; Jan 2020 – Present*

- UBC's professional Master of Data Science program is a year-long intensive, cut into 6 blocks of courses and a capstone project.
- Facilitated course labs. Hosted office hours and problem solving sessions. Developed detailed assignment solutions. Marked and provided detailed feedback for students' assignment submissions. Provided feedback and review of draft assignments before they were released to students.
- Detailed course descriptions available here. A list of courses for which I've served as TA are included below.
- 2017: Descriptive Statistics and Probability for Data Science, Communication and Argumentation, Data Wrangling, Supervised Learning I, Feature and Model Selection, Statistical Inference and Computation II, Experimentation and Causal Inference
- 2018: Communication & Argumentation, Data Wrangling, Databases and Data Retrieval, Unsupervised Learning, Spatial & Temporal Models, Web and Cloud Computing
- 2019: Descriptive Statistics and Probability for Data Science, Statistical Inference and Computation I, Supervised Learning I, Supervised Learning II, Spatial and Temporal Models, Advanced Machine Learning
- 2020: Supervised Learning II, Unsupervised Learning, Advanced Machine Learning

Master of Data Science program University of British Columbia
Courseware developer *Summer 2020*

- Developed and adapted all lecture and lab learning resources for Supervised Learning II and Advanced Machine Learning from Tensorflow to PyTorch.

Multivariable and Vector Calculus University of British Columbia
Teaching Assistant *Jan 2015 – Apr 2015*

- Second year calculus for electrical engineers; co-syllabus with the electrical engineering electrodynamics course.
- Graded students' midterms and biweekly assignments; required knowledge of electrodynamics, multivariable calculus, linear algebra.

Math Learning Centre University of British Columbia
Teaching Assistant *Sep 2015 – Dec 2016*

- Served in several roles for a drop-in help centre run by the Math Department.
- "Quick-help TA": given a strict two minute duration in which to respond to student questions. Peak hours popularity demand high energy, on-the-spot ingenuity, concise clarity
- "TA in-charge": ensure TAs evenly distribute among students; collect regular data on number of students, TAs; help students when other TAs are indisposed.
- "TA": create novel explanations for class-learned concepts to address student questions.

Biology, Models and Mathematics University of Toronto
Teaching Assistant *Sept 2013– Apr 2014*

- First year math course for Biology students, requiring instruction to be delivered in a way that is relevant and appropriate for Biology students.
- Graded students' weekly assignments and provided feedback to students' instructor.
- Held two weekly hour-long office hours that were well-attended.

Engineering Mathematics IV McMaster University
Undergraduate Teaching Assistant *Jan – Apr 2013*
Jul – Aug 2012

- Second-year second-term Engineering Mathematics course covering vector calculus, Fourier series, linear algebra, graphical visualization and MATLAB.
- Graded students' midterms, weekly lab assignments.
- Led two twice-weekly labs to review course content using slides I created in LaTeX
- Responded to students' questions via e-mail and during office hours.

Calculus for Math and Stats I McMaster University
Undergraduate Teaching Assistant *Sept – Dec 2012*

- Designed and conducted weekly one-hour tutorial; supervised in-tutorial quizzes.

- Prepared creative, rigorous examples to stimulate students' interest, develop intuition and mathematical insight.
- Answered students questions via e-mail and in the Math Help Centre.

Undergraduate mathematics Ontario, Canada
Private Tutor *Jan 2012–Present*

- Tutor for calculus, statistics, differential equations, computer science, complex analysis
- Create study curriculum tailored to student's needs
- Experience with language barriers, mature students, students with disabilities and destination-not-the-journey type students

Other Outreach & Service

Tutor UBC First Nations House of Learning
UBC Longhouse drop-in tutoring *Sept 2020 – Present*

- Drop-in tutoring sessions for (typically first-year) indigenous students at UBC.
- Primary focus on calculus, word problems and problem solving skills.

Convener UBC IAM, UBC DSI, PIMS, CANSSI
BC Data Colloquium *Jan 2017 – Aug 2018*

- Organized speakers for a monthly colloquium.
- Talk descriptions available at bcdata.ca.

CMS Student Committee (STUDC) Canadian Mathematical Society
Co-Chair, Student Director *Jun 2015 – Jun 2018*

- Coordinated and directed operations of the (national scale) CMS student committee and its members.
- Managed the largest budget of any CMS committee.
- Served as representative of Canadaian math students and as liaison with CMS leadership.
- Reviewed student conference funding proposals, and awarded student prizes for academic achievement in the form of poster printing subsidies and conference bursaries.