Duncan Bennett

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Research Interest

I am currently interested in the use of energy based models in machine learning. In particular, the use of modern Hopfield networks and dense associative memory for supervised and unsupervised tasks.

Education

- **University of Arizona** — Tucson, AZ
  PhD in Mathematics; (in progress) — *Aug. 2019 – Present*

- **Western Washington University** — Bellingham, WA
  Master of Science in Mathematics; GPA: 3.94 — *Sept. 2016 – June. 2018*
  - MS Project : Classification of Finite Group Extensions and Group Cohomology

- **University of Puget Sounds** — Tacoma, WA
  Bachelor of Science in Mathematics; GPA: 3.44 — *Aug. 2015 – May. 2015*
  - Senior Thesis : Algebraic Topology

Research Experience

- **Response-guided Principal Component Classification**
  Supervisor: ***Prof Helen Zhang*** *University of Arizona* — *Aug. 2020-Aug 2021*
  - The adaptation of response-guided principal component regression to logistic regression for binary classification.
  - Improvements to convergence, robustness compared to logistic regression by reformlating in terms of principal components. Improvement by factor of 10 to 100 in Kullback-Leibner divergence with respect to density estimation.
  - Written in R with glmnet, ggplot2 and original library

- **Scoliosis Medical Imaging**
  Supervisor: ***Prof Marek Rychlik*** *University of Arizona* — *July 2021-Dec. 2021*
  - Build and train CNN with up/down sampling to preform semantic segmentation of spine X-rays.
  - From semantic segmentaion, train output layer for quadrilateral estimation of vertebra and calculation of Cobb angle using techniques from density estimation.
  - Preliminary results show improvements in quadrilateral segmentation accuracy compared to tradiation regression approaches.
  - Written in MATLAB with image processing and fuzzy logic toolkits.

- **Supervised Principal Component Regression**
  Supervisor: ***Prof Ning Hao*** *University of Arizona* — *July 2021-Aug. 2021*
  - Developed dimension reduction methods that principal components based on the covariance of the predictors and variance of the response data.
  - Written in R with glmnet, ggplot2 and original library.

- **The Order Complex of Cyclic Groups and its Homotopy Type**
  Supervisor: ***Prof James Bernhard*** *Univeristy of Puget Sound* — *May 2011-Oct. 2011*
  - The subgroup lattice functor distributes over direct products and thus for abelian groups, the question of homotopy type can be reduced down to that of the maximal p-subgroups. This results in the subgroup lattice is homotopy equivalent to a wedge of spheres of varying dimension.

Technical Skills

- **MATLAB**: Familiarity with MATLAB for machine learning and toolboxes such as Statistics and Machine Learingn, Deep Learning, Image Processing, Signal Processing, DSP System and Fuzzy Logic.
- **R**: Familiarity with R for statistical analysis and libraries such as dplyr, ggplot2, knitr, and glmnet.
- **Python**: Familiarity with python for statistical and numerical analysis and libraries such as NumPy, SciPy, Pandas, Matplotlib
- **Computer Skills**:
  - Git/Github
  - Linux (Ubuntu, Fedora)
  - Emacs
  - Command line and terminal navigation
- **Relevant Coursework**: Statistical Machine Learning, Numerical Analysis and Algorithms, Experiment Design, Advanced Regression Analysis, Probability, Statistics, Natural Language Processing.

Presentations and Talks

- **Speech and Language Processing** — Tucson, AZ
  Univeristy of Arizona : Multilingual OCR Seminar — *Spring 2022*
- **Response-guided Principal Component Classification** — Tucson, AZ
  Univeristy of Arizona : RTG Mini Conference — *Dec 2020*
- **The Order Complex of Cyclic Groups and its Homotopy Type** — Bellingham, WA
  Western Washington University : Western's Association of Mathematics (WαM) — *May 2018*
- **The Cohomology of Finite Groups and Group Extensions** — Bellingham, WA
  Western Washington University : Mathematics Department Colloquium — *May 2018*
- **The Order Complex of Cyclic Groups and its Homotopy Type** — Tacoma, WA
  University of Puget Sound : Math/CS Seminar — *April 2016*

Awards

- **Galileo Circle Award**
  (University of Arizona) — *August 2022*
- **Outstanding Masters Graduate Award**
  (Western Washington University) Academic Merit — *May 2018*
- **Elias Bond Graduate Fellowship**
  (Western Washington University) Academic Merit — *May 2017*
- **Richard Greene Graduate Scholarship**
  (Western Washington University) Academic Merit — *May 2017*

Extra Curricular

- **Pi Mu Epsilon (Math Honors Society)** — Tacoma, WA
  Founding Member of University of Puget Sound chapter — *2015*
- **ASU ASA DataFest Mentor** — Online/AZ
  Graduate Student Mentor — *2021-2022*
  - Mentored undergraduate competitors through fast-paced data competition using large datasets from industry.
  - Provide tutorials in data analysis topics such as data wrangling, data cleaning and machine learning.