Raphaël Barish Walker

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Publications

Benchmarking the Borg algorithm on the bbob-biobj testbed
GECCO '23: BBOB Workshop *2023*
With D. Brockhoff, P. Capetillo, and J. Hornewall

The Borg MOEA is an optimization algorithm, designed to handle real-world problems of a multi objective and multimodal nature. We benchmark the performance of the algorithm on the bbob-biobj test suite via the COCO platform, comparing it to current state-of-the-art algorithms. We also develop a custom parameter tuning scheme, which substantially improves Borg's performance on the test suite without problem-specific information.

How Many Cards Should You Lay Out in a Game of EvenQuads: A Detailed Study of Caps in AG$(n, 2)$
La Matematica, Vol. 2 No. 2 *2023*
With J. Crager, F. Flores, T. Goldberg, L. Rose, D. Rose-Levine, and D. Thornburgh

We define a cap in the affine geometry $\mathrm{AG}(n, 2)$ to be a subset in which any collection of 4 points is in general position. We classify, up to affine equivalence, all caps in $\mathrm{AG}(n, 2)$ of size at most $k \leq 9$.

A Small Maximal Sidon Set in $\mathbb{Z}_2^n$
Siam Journal of Discrete Mathematics, Vol. 36 No. 3 *2022*
With M. Redman and L. Rose

A Sidon set is a subset of an Abelian group with the property that each sum of two distinct elements is distinct. We construct a small maximal Sidon set of size $O((n \cdot 2^n)^{1/3})$ in the group $\mathbb{Z}_2^n$, generalizing a result of Ruzsa concerning maximal Sidon sets in the integers.

Lagrangian Cobordisms of Legendrian Pretzel Knots with Maximal Thurston-Bennequin Number
Undergraduate Senior Thesis, Bard College *2021*
With C. Leverson

In the study of Legendrian knots, which are smoothly embedded circles constrained by a differential geometric condition, an actively-studied problem is to find conditions for the existence of Lagrangian cobordisms, which are Lagrangian surfaces whose slices resemble specific Legendrian knots at each end. We demonstrate a family of knots where each has a maximal-tb representative admitting a Lagrangian cobordism from a stabilized Legendrian unknot.

Academic Experience

Université Paris-Saclay *Orsay, France* 2023
Master of Science, Mathematics of Artificial Intelligence

INRIA *Saclay, France* Summer 2023
CELESTE Team, Research Intern
Advisor: Étienne Boursier

- Studied the convergence of gradient descent for shallow neural networks.
- Investigated the phenomenon where classification problems are "easier to solve" than regression problems with the same data.
- Found simple examples where infinitely-wide neural networks converge to a suboptimal local minimum.

Bard College *Annandale-On-Hudson, New York* 2021
Bachelor of Arts, Mathematics Major *GPA 4.0*
Artine Artinian Scholar 2019–2020
Mathematics and computer science tutor

Bard Summer Research Institute Summer 2021
Research Assistant, Mathematics
Mentor: Prof. Lauren Rose

- Investigated the size of maximal and minimal generalized caps in finite affine spaces.
- Introduced other students in the research group to the material and supported their exploration of related problems.
- Wrote programs to compute cap sizes in specific affine spaces through optimized brute-force search.
- Created a webapp to visualize generalized affine caps.

Bard College at Simon's Rock *Great Barrington, Massachusetts* 2019
Associate of Arts *GPA 3.9*
Mathematics, computer science, and French tutor
Dean's List

Work Experience

Flim Fall 2023—
Machine Learning Research Scientist

- Assisted with a collaboration between visual artists Gérard Garouste and Neil Beloufa, using machine learning models trained on their artworks.
- Built a generative AI system for "combining" pairs of images. Applied cutting-edge fine-tuning objectives to create and insert custom layers into foundation models.
- Built a pipeline to extract the most aesthetically pleasing images from a video. Trained a custom preference model on a large-scale internal dataset, and performed intensive optimization to enable efficient CPU inference.

Invisible College 2021—2023
HCI Researcher, Remote

- PeeryView.org
- Prototyped and built an online tool implementing decentralized and subjective peer review, and archival and discussion of web links.
- Collaborated with the PeeryView design team to determine the tooling needs of the scientific community.

– Served as ML/science advisor to a psychiatric team building a prototype of an LLM-based cognitive behavioral therapy program.

Invisible College Summers 2019, 2020
Research Assistant

– Designed and developed a set of decentralized synchronization protocols and algorithms.
– Co-authored IETF draft for universal synchronization protocol.
– Created Javascript and NodeJS tools to analyze and debug synchronization algorithms, including a universal protocol translation demo and a peer-to-peer sync visualization.
– Contributed to client and server code for the BraidJS library.

Speakeasy Digital Media Fall 2018
Web Developer, Remote

– Created and modified WordPress PHP templates for company blogs.
– Improved page load times by up to ten times by optimization on both front-end page loading and back-end content generation.

Storefront Political Summer 2018
Data Science Intern

– Analyzed pre-electoral polls, including weighting, cross-tabulating, raking, and cleaning.
– Created R and Python scripts to automate common tasks such as matching ZIP codes to voting districts and visualizing survey results.
– Designed and implemented a webapp for interactive visualization of survey results.
– Managed large PostgreSQL databases containing voter information.

Omnisparx Fall 2017—Spring 2018
Intern

– Researched and reported on the state of blockchain technology to educate app users and inform development for blockchain startup.
– Reported directly to CEO.