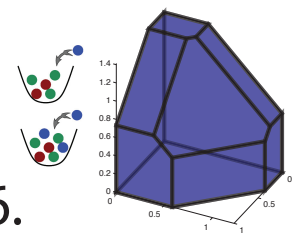


$$f(C) \geq f(A \cap B)$$

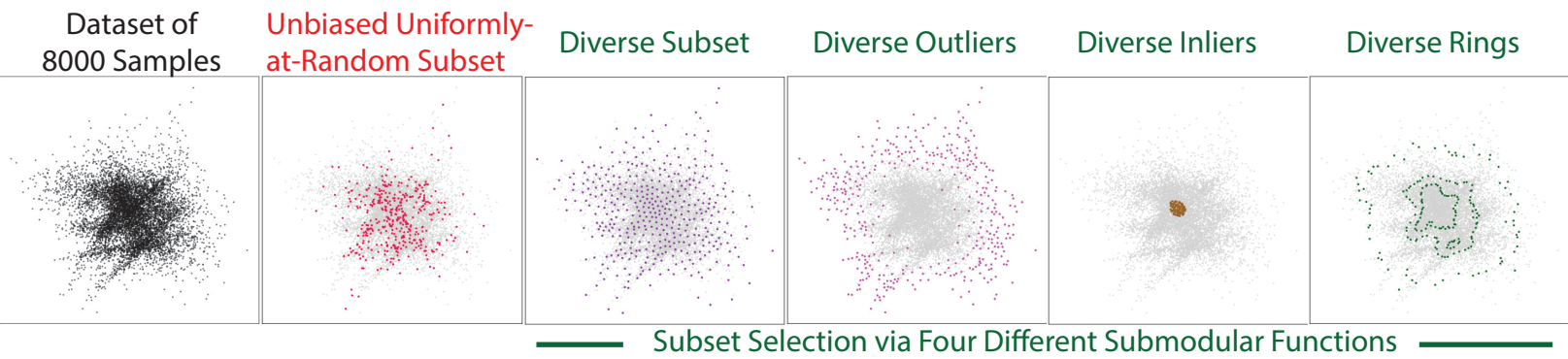
EE 563: Submodular Optimization

Fall Quarter, 2024



Days/Time: M W, 10:30-12:20PM, ECE 026.

Submodularity can be seen as a discrete analog to convexity and has many applications in machine learning and artificial intelligence. This course will provide a thorough introduction to submodular and supermodular functions and their relevance in these fields.



Applications

- Coresets, sketches, and summarization
- Mini-batch selection and ordering for ML training
- KV cache compression for large language models
- Diversity and heterogeneity modeling
- Clustering and high tree-width probabilistic modeling
- Game theory, convex cores, the Shapley value
- Active learning and compressed sensing
- Bias and fairness in AI
- Efficient model training and green AI
- Detecting disease outbreaks
- Structured convex norms and sparsity
- Recommendation systems and causal structure
- Brain parcellation
- Applications in natural language processing, computer vision, and computational biology

Course Requirements

- Homework: Regular assignments to reinforce learning.
- Final Project: A comprehensive project to apply course concepts.

General Topics

- Foundational Concepts:
 - Properties, closure operations, variants, and special cases
 - Computational properties and relationships to graph theory
- Theories
 - The theory of matroids and lattices
 - Functions on integer lattices and continuous spaces (e.g., non-convex DR functions)
- Polyhedral Properties
 - Matroid and polymatroidal polyhedra
 - Semidifferential structures
- Extensions
 - The Lovasz extension
 - The Choquet integral
 - Multi-linear extension
 - Other convex/concave extensions
- Optimization Algorithms:
 - Maximization/minimization algorithms under constraints
 - Greedy algorithms and other centralized and parallel/distributed algorithms

$\partial_i^-(\{v_i\})$	$\partial_i^-(\{v_1, v_2\})$
∂_i^0	$\partial_i^+(\{v_i\})$

Join us for an in-depth exploration of submodularity and its powerful applications in machine learning and AI.

