

Advanced Topics in Algorithms: Algorithms for Submodular Optimization

נושאים מתקדמים באלגוריתמים: אלגוריתמים לאופטימיזציה תת-מודולרית

236621

Overview:

Submodular functions, which capture the property of diminishing returns, are ubiquitous in various disciplines, including combinatorics, graph theory, machine learning, economics, algorithmic game theory, and information theory. The family of submodular maximization and minimization problems is a prime example of a unified approach that captures both well-known classic problems, e.g., Max-Cut, Max-DiCut, and Generalized Assignment, and real-world applications in diverse settings, e.g., information gathering, image segmentation, viral marketing in social networks, and recommendation systems. This course deals with the algorithmic foundations of submodular optimization, focusing on basic problems and algorithmic techniques.

Topics:

1. Introduction to submodularity.
2. Submodular maximization with a cardinality constraint.
3. Unconstrained submodular maximization.
4. Introduction to matroids.
5. Continuous extensions of submodular functions.
6. Solving the multilinear relaxation.
7. Rounding methods (pipage and swap rounding).
8. Submodular minimization.
9. The submodular multiway partition problem.

If time permits, additional related topics will be covered, e.g., fast algorithms for submodular maximization and constrained submodular minimization.

Learning Outcome:

Familiarity with submodularity and the theoretical algorithmic foundation of the design and analysis of algorithms for optimization problems with a submodular objective. Algorithms will use both discrete, randomized, and continuous approaches.

Prerequisites:

- Algorithms 1 (234247).
- Computability Theory (236343).
- A course in probability.
- Highly recommended: Algorithms 2 (236359) or Approximation Algorithms (236521).

Staff and Times:

Monday 15:30-17:30 (lecture) – Roy Schwartz

Monday 13:30-14:30 (tutorial) – Dor Katzelnick

Grading Policy:

By homework and possibly a project.