

## **Algorithms for Submodular Optimization**

### **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:**

The following will be covered in the course:

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.

### **Prerequisites:**

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

### **Grading Policy:**

By homework, there will be no final exam.