

**CSCI 2510: Approximation Algorithms** (Spring 2018)  
11:00-12:00 on Monday, Wednesday, Friday  
CIT 477

**Instructor:** Philip Klein (klein@brown.edu)

**Office Hours:** By appointment.

**Prerequisites:** You must have passed a course on algorithms equivalent to CSCI1570 (*Design and Analysis of Algorithms*).

**Textbook:** *The Design of Approximation Algorithms* by David P. Williamson and David B. Shmoys (available to purchase and online)

**Other readings:** Research papers, to be provided.

### Subject of the course

Approximation algorithms are one tool to help cope with the fact that so many important and interesting problems in discrete optimization are (apparently) computationally intractable: an algorithm that reliably finds the optimal solution would take too long on large instances. An approximation algorithm for an optimization problem is an algorithm that, for every input instance, returns a solution whose quality is nearly as good as the quality of the best solution. That is, the algorithm comes with a mathematical proof that the solutions are good in this sense. For many classical NP-hard problems in discrete optimization, there are polynomial-time approximation algorithms.

This course is an introduction to the techniques and results of the field of approximation algorithms. A student who successfully completes the course should understand many of these techniques and be in a position to try applying them to new optimization problems or to read papers in the research literature that present such algorithms.

### Work

The course will consist of lectures (three hours per week), homeworks, and a final term paper. There will be 5-6 homework assignments. Solving the problems and writing them up is expected to take roughly ten hours per week. Students are permitted to work collaboratively on the homeworks. However, your writeup must be done in private, without the benefit of any record of the collaborative work except what you can remember.

Each student's term paper will be based on a research paper selected jointly by the student and the professor. Work on the final project will occupy the last one-fourth of the course, and is expected to require roughly ten hours per week.

## Outline

The following is an approximation to the list of topics addressed. It mostly follows the development in the textbook. My best guess as to the schedule is on the course calendar (which can be found at the course web site).

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- Introduction, Ch 1: Set cover via deterministic rounding
- Ch 1: Set cover via rounding a dual solution, greedy algorithm
- Ch 4: Deterministic rounding: prize-collecting Steiner tree
- Ch 4: Deterministic rounding: uncapacitated facility location
- Ch 5: Randomized Rounding: integer multicommodity flow
- Ch 7: Primal-dual method: feedback vertex set
- Ch 7: Primal-dual method: Steiner forest
- Ch 8: Multiway cut
- Ch 8: Multicut
- Ch 8: Multicut
- Ch 10: Maximum independent set in planar graphs
- Ch 11: Minimum-cost bounded-degree spanning trees
- Ch 11: Minimum-cost bounded-degree spanning trees
- Ch 11: Survivable-network design
- Ch 11: Survivable-network design
- Ch 14: Primal-dual and prize-collecting Steiner tree
- Ch 14: Primal-dual and prize-collecting Steiner tree
- Ch 15: Oblivious routing and cut-tree packings
- Ch 15: Oblivious routing and cut-tree packings
- Ch 15: Cut-tree packings and minimum bisection
- Ch 15: Cut-tree packings and minimum bisection
- Advanced topics and/or student lectures