CSCE 669-601 Computational Optimization

Spring 2024

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Assignment #3

(Due April 24)

1. Johnson's Algorithm. In the class, we presented an analysis that shows that Johnson's Algorithm for Max-Sat has an approximation ratio bounded by 5/3. Write out all details of this analysis. Note that in the analysis given in the class, we assumed that the input instance contained no conflicting unit clauses, i.e., both clauses (x_i) and $(\overline{x}_i)$ for a variable x_i. You should show that even when the input instances contain conflicting unit clauses, the ratio 5/3 still holds true for Johnson's Algorithm.

Alternatively, if you have any idea that is significantly different from the above to show that Johnson's Algorithm has a ratio strictly smaller than 2, even that ratio is larger than 5/3, you can give the analysis for your own ratio, replacing a solution to the above question.

2. 3-Dimensional Matching. Write a polynomial-time approximation algorithm for the following 3D-Matching problem: given a set S of n points in the 3-dimensional Euclidean space, find a maximum subset M of S such that no two points in M have the same value on any coordinate. Your algorithm should have an approximation ratio not larger than 3. (**Remark:** a ratio 2 can be achieved with a little more efforts, and the currently best ratio is $1.5 + \epsilon$.)

3. Disk-Cover. Consider the following problem: given n points in the plane, find a minimum number of unit disks (i.e., disks of radius 1) that contain all given points. The problem is known to be NP-hard. Develop a polynomial time constant-ratio approximation algorithm for the problem, and analyze the approximation ratio for your algorithm.