Advanced Algorithms: Assignment 1

August 28, 2019

Instructions:

1. Discussions are not encouraged for the first part of the assignment. If at all you discuss with anyone or consult a reference for the first part, you should clearly mention it.
2. Copying others' assignments is **strictly** prohibited.
3. For the second part, you are encouraged to discuss, consult existing literature and find out the answer, and of course, are still required to mention the source(s).

Part 1

1. Give a tight example for Christofide's algorithm.
2. Show that the LPT rule gives an optimal schedule if all the jobs have processing time larger than $\frac{\mathsf{OPT}}{3}$.
3. Give an f-approximation algorithm for set cover where f is the maximum number of sets any element appears in.

Part 2

1. We have seen that the problem of finding a min-cost traveling salesman tour with no restriction on costs except non-negativity can not be approximated to any factor unless P=NP. Is it true even for max-TSP where instead of a min-cost tour, the goal is to find a max-cost tour (imagine that the edge-weights are incentives rather than costs, and hence the max-version makes sense)? If not, why and what is the best known approximation for max-TSP when there is no restriction on edge-weights apart from non-negativity?
2. Define the bin-packing problem. What is the relation between list scheduling and bin packing?
3. It was mentioned in the class that there is no FPTAS for list scheduling unless P=NP. Why? Define strong NP-completeness and show that no strongly NP-complete problem has an FPTAS unless P=NP.