

CS091M4041H: Assignment 7

Institute of Computing Technology,
Chinese Academy of Sciences, Beijing, China

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Notice:

1. You do **NOT** need to submit neither digital version nor hard copy of the assignment, but you need to finish the homework. Because some of the problems may appear to the final exam with some modifications.
2. When you're asked to give an algorithm, you should do the following things:
 - Describe the basic idea of your algorithm in natural language **AND** pseudo-code;
 - Prove the correctness of your algorithm.
 - Analyse the complexity of your algorithm.

1 Bin Packing

Bin Packing is as follows: Given n items with sizes $a_1, \dots, a_n \in (0, 1]$, find a packing in unit-sized bins that minimizes the number of bins used.

Give a 2-approximation algorithm for this problem and analyse the approximation factor.

2 Steiner Tree Problem

Given an undirected graph $G = (V, E)$ with edge costs and set $T \subseteq V$ of required vertices, the *Steiner Tree Problem* is to find a minimum cost tree in G containing every vertex in T (vertices in $V - T$ may or may not be used in T).

Give a 2-approximation algorithm if G is complete and the edge costs satisfy the triangle inequality.

3 Vertex Cover

Consider the following algorithm for (unweighted) **Vertex Cover**: In each connected component of the input graph execute a depth first search (DFS). Output the nodes that are not the leaves of the DFS tree.

Show that the output is indeed a vertex cover, and that it approximates the minimum vertex cover within a factor of 2.

4 MAX-3SAT

Given a set of clauses $C_1, \dots, C_n$, each of length 3, and you need to find an assignment to maximize the number of satisfied clauses.

Please find a approximation algorithm to solve the problem and give the approximation factor.