Lab13-NPReduction

CS363-Computability Theory, Xiaofeng Gao, Spring 2016

∗ Please upload your assignment to FTP or submit a paper version on the next class
∗ If there is any problem, please contact: steinsgate@sjtu.edu.cn
∗ Name:_____ StudentId: _____ Email: _____

1. Find the certificate and certifier for the decision version of the following problems.

   (a) Clique: Given an undirected graph, find a subset S that there is an edge connecting every pair of nodes in S with maximum nodes.

   (b) Metric k-center: Given n cities with specified distances for each pair of cities as d_{ij}, one wants to build k warehouses in different cities and minimize the maximum distance of a city to a warehouse.

   (c) Set Packing: Given a set U of n elements, a collection $S_1, \cdots, S_m$ of subsets of U, find the maximum subsets such that no two of them intersect.

   (d) minimum k-cut: Given a weighted graph $G = (V, E)$, we want to find a minimum weighted set of edges whose removal would partition the graph to k connected components.

2. The knapsack problem is a well-known optimization problem. Given a set of n items, each item i with a weight w_i and a value v_i, determine the number of each item to include in a collection so that the total weight is less than or equal to a given limit W and the total value is as large as possible.

   Prove that the knapsack problem is NP-complete. (Hint: One solution is reducing the Subset Sum problem to it.)

3. We know that $\mathbf{P} \subseteq \mathbf{NP} \cap \mathbf{co\text{-}NP}$. Please give an example that belongs to following set. If you can, briefly explain your reason. (Should be examples different from the course slides).

   (a) **Co-NP**.

   (b) **Co-NP** $\cap$ **NP-hard**.

   (c) **Co-NP** $\cap$ **NP**, but not known to be in **P**.