# Problem sheet 4

Please feel free to discuss these problems on the unit discussion board or directly with your colleagues. If you would like to have your answers marked, please either hand them in in person at a lecture or problems class. Submitted work will be marked as quickly as possible, ideally within one week of being handed in.

1. Consider the optimisation and decision versions of the Bin Packing.

   In the optimisation version we ask for assignment of all the packages to bins using the least possible number of bins such that the sum of sizes of all packages in a bin is at most 1. In the decision version we are given a positive integer $K$ as part of the input and asked if there exists a packing of all the packages into at most $K$ bins such that the sum of sizes of all packages in a bin is at most 1.

   (a) Show how to solve the decision version of bin packing using the optimisation version. How many calls to the optimisation version does your reduction require ?

   (b) Show how to solve the optimisation version of bin packing using the decision version. How many calls to the decision version does your reduction require ?

2. Minimum vertex cover is a problem in graph theory. Given a graph $G = (V, E)$, a vertex cover is a set of vertices such that each edge in the graph is incident to at least one of vertex in the set, thus all edges are "covered" by that set of vertices. The set of all vertices, $V$, is one valid example of vertex cover. The problem is NP-hard.

   (a) Give a simple greedy 2-approximation algorithm for the minimum vertex cover problem.

   (b) Show correctness for your algorithm.

3. Prove there is no FPTAS for minimum vertex cover unless P = NP.