CSC-421 Applied Algorithms and Structures
Winter 2017

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Assignment #1

(Due January 27)

Note. When asked to give an algorithm that meets a certain time bound, you need to give the algorithm (pseudocode/description) and analyze its running time to show that it meets the required bound; giving only the algorithm is not enough to receive full credit.

Please upload your submission as a single PDF file on D2L. If your submission consists of more than one file, convert all your files into a single PDF file and upload it.

1. Given a collection of n nuts and a collection of n bolts, arranged in an increasing order of size, give an $O(n)$ time algorithm to check if there is a nut and a bolt that have the same size. The sizes of the nuts and bolts are stored in the arrays $NUTS[1..n]$ and $BOLTS[1..n]$, respectively.

2. Let $A[1..n]$ be a sorted array of numbers, and t be a number. Give an $O(n)$ time algorithm to decide if there are two indices $1 \leq i < j \leq n$, such that $A[i] + A[j] = t$.

3. Textbook, page 1066, exercise 34.2-6.

4. Textbook, page 1086, exercise 34.4-5 (look for the definition of disjunctive normal form in chapter 34 of the textbook).

5. Textbook, page 1086, exercise 34.4-6.

6. Assuming P $\neq$ NP, for each of the problems below, say whether it is solvable in polynomial time or whether it is NP-complete, and justify your answer. (That is, if you say that the problem is polynomial-time solvable, explain how it can be solved in polynomial time; and if you say that it is NP-complete, give a polynomial-time reduction from an NP-complete problem to it.)

   (a) Given n coins of two different denominations (values), that is some coins are worth x dollars and some are worth y dollars, decide if the coins can be partitioned into two parts that have the same monetary value.

   (b) Given n checks, each of arbitrary (integer) monetary value, decide if the checks can be partitioned into two parts that have the same monetary value.

   (c) Given an undirected graph G, decide if G has an independent set of 5 vertices.